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(NASA-CR-134432) - SUBSONIC AND TRANSONIC HINGE MOMENT AND WING BENDING/TORSION CHARACTERISTICS OF ... 015 SCALE SPACE SHUTTLE MODELS 49-0 AND 67-TS IN THE (Chrysler Corp.) 809 p HC .\$19.25

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SPACE SHUTTLE

AEROTHERMODYNAMIC DATA REPORT



JOHNSON SPACE CENTER

HOUSTON, TEXAS

DATA MANagement 'services



DMS-DR-2175 NASA CR-134,432 VOLUME 2 OF 3

SUBSONIC AND TRANSONIC HINGE MOMENT AND

WING BENDING/TORSION CHARACTERISTICS OF .015

SCALE SPACE SHUTTLE MODELS 49-0 AND 67-TS IN THE

ROCKWELL INTERNATIONAL TRISONIC WIND TUNNEL (1A70)

Ву

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Prepared under NASA Contract Number NAS9-13247

Ву 、

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for

Engineering Analysis Division

Johnson Space Center
National Aeronautics and Space Administration
Houston, Texas

WIND TUNNEL TEST SPECIFICS:

Test Number: Rockwell Trisonic - 282

NASA Series Number: IA70

Model Numbers: 49-0, 67-TS

Test Dates: 3 through 24 May 1974

Oeeupancy Hours: - 161

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WING BENDING/TORSION CHARACTERISTICS OF .015
SCALE SPACE SHUTTLE MODELS 49-0 AND 67-TS IN THE
ROCKWELL INTERNATIONAL TRISONIC WIND TUNNEL (1A70)

Ву

M. T. Hughes and R. C. Mennell Rockwell International Space Division

ABSTRACT

Experimental aerodynamic investigations were conducted on an 0.015-scale representation of the VL70-000140A/B Integrated Space Shuttle Launch Vehicle in the Rockwell International Trisonic Wind Tunnel from 3 May 1974 to 24 May 1974. The primary test objective was to obtain subsonic and transonic elevon and bodyflap hinge moments and wing bending-torsion moments in the presence of the launch vehicle. Wing pressures (42) were also recorded for the upper and lower right wing surfaces at two spanwise stations (n = 0.436 and 0.771).

The hinge moment, wing bending/torsion moments and wing pressure data were recorded over an angle-of-attack (α) range from -8° to +8°, an angle-of-sideslip (β) range from -8° to +8° and at Mach numbers of 0.90, 1.12, 1.24 and 1.50. The Reynolds number for all Mach numbers was approximately 7.0 x 10^6 /foot.

Outboard elevon deflections of 0°, $\pm 4^\circ$ and $\pm 8^\circ$; inboard elevon deflections of 0°, $\pm 4^\circ$, $\pm 8^\circ$ and $\pm 12^\circ$; and bodyflap deflections of 0° and

+10° were tested over the entire Mach number range.

Tests*were also conducted to determine the effects of the Orbiter rear attach cross beam and the forward attach wedge and strut diameter. The Orbiter alone was tested at 0.90 and 1.24 Mach number only.

For both the Orbiter alone and integrated configurations the models were sting mounted on a dummy 1.5-inch Task MK XXVII balance pinned in the Orbiter.

This report consists of three volumes arranged in the following manner:

Volume 1 - Plotted and tabulated force data

- Plotted pressure data - Figures 25 and 26

Volume 2 - Plotted pressure data - Figures 27 through 32

Molume 3 - Tabulated pressure data

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- (A) CHEO, CHEI, CHBF, CBW, CTW versus ALPHA
- (B) CHEO, CHEI, CHBF, CBW, CTW versus ALPHA CHEO, CHEI versus ELV-LI
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- (E) CP, DCP versus X/C

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NOMENCLATURE General

SYMBOL	PLOT SYMBOL	DEFINITION
а		speed of sound; m/sec, ft/sec
c_p	CP	pressure coefficient; $(p_1 - p_{\infty})/q$
М	MACH	Mach number; V/a
р		pressure; N/m ² , psf
q	Q(NSM) Q(PSF)	dynamic pressure; $1/2\rho V^2$, N/m^2 , psf
\mathtt{RN}/\mathtt{L}	RN/L	unit Reynolds number; per m, per ft
V		velocity; m/sec, ft/sec
α	ALPHA	angle of attack, degrees
β	BETA	angle of sideslip, degrees
ψ	PSI	angle of yaw, degrees
ϕ	PHI	angle of roll, degrees
ρ		mass density; kg/m ³ , slugs/ft ³
	Refe	erence & C.G. Definitions
Ab 、		base area; m ² , ft ²
b	BREF	wing span or reference span; m, ft
c.g.		center of gravity
$oldsymbol{\ell_{ ext{REF}}}_{ ilde{ iny c}}$	LREF	reference length or wing mean aerodynamic chord; m, ft
S	SREF	wing area or reference area; m^2 , ft^2
	MRP	moment reference point
	XMRP	moment reference point on X axis
	YMRP	moment reference point on Y axis
	ZMRP	moment reference point on Z axis
SUBSCRIPT	<u>'S</u>	
ь 1		base local
s		static conditions
t ∞		total conditions free stream

NOMENCLATURE (Continued) Additions to Standard Listing

Symbol	Plot <u>Symbol</u>	Description
a _m	•	distance from m_1 to m_2 gage, in
В		wing panel bending moment, in-lbs
c_{BF}		bodyflap reference chord, in
c _e		elevon reference chord, in
$c_{B^{M}}$	CBW	wing bending moment coefficient
c _{heI}	CHEI	inboard elevon hinge moment coefficient
c _{he0}	CHEO	outboard elevon hinge moment coefficient
С _{ћеТ}	CHET	total elevon hinge moment coefficient
c_{h_BF}	CHBF	bodyflap hinge moment coefficient
c^{\perp^M}	CTW	wing torsion moment coefficient
c_p	СР	local pressure coefficient
$c_{P_{LE}}$	CPLE	wing leading edge pressure coefficient
Ç _{PWL}	CPWL	wing lower surface pressure coefficient
$\mathfrak{c}_{P_{WU}}$	CPWU	wing upper surface pressure coefficient
$c_{P_{T}}$	DCP	total (differential) wing pressure coefficient, (upper - lower)
d		distance from m_2 to exposed wing root chord, in

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NOMENCLATURE (Continued) Additions to Standard Listing

e _m		distance from m_3 to torsion reference center, in
H _{BF}		bodyflap hinge moment, in-1b
H _e I		inboard elevon hinge moment, in-1b
H _{e0}		outboard elevon hinge moment, in-1b
m _i		wing bending gage moment at station i, in-1b
N_{W}		wing panel normal force, lbs
P _W LE		wing leading edge pressure, psi
PWL		wing lower surface pressure, psi
P_{W_U}		wing upper surface pressure, psi
\$ _{BF}		bodyflap reference area, ft ²
S _e		elevon reference area, ft ²
T _W		wing panel torsion moment, in-lb
x/c	X/C	chord wise location, fraction of local chord
2Y/b,ŋ	2Y/B	spanwise location, fraction of wing span
^δ e _{OL} , ^δ e1	ELV-1 ELV-LO	lefthand outboard elevon deflection angle, deg
δ _{eIL} ,δe2	ELV-2 ELV-LI	lefthand inboard elevon deflection angle, deg
δ _{e IR} ,δe3	ELV-3 ELV-RI	righthand inboard elevon deflection angle, deg

NOMENCLATURE (Concluded) Additions to Standard Listing

^δ e _{OR} , δe4.	ELV-4 ELV-RO	righthand outboard elevon deflection angle, deg
⁶ eI	DEI	inboard elevon deflection angle, average of left and right inboard panels, deg
^δ e0	DEO	outboard elevon deflection angle, average of left and right outboard panels, deg
δ_{BF}	BFLAP	bodyflap deflection angle, deg

CONFIGURATIONS INVESTIGATED

The model used for this test period was an 0.015-scale representation of the Rockwell International VL70-000140A/B Space Shuttle Orbiter and Integrated Launch Vehicle. The Orbiter model was of the blended wing-body design with double delta wing planfrom (75°/45° Λ_{LE}), full span split elevons with unswept hingeline, centerline vertical tail with rudder/speed-brake capability, fuselage canopy and orbital manuevering system (OMS pods) mounted on the aft fuselage sidewalls. The elevon panels were segmented into inboard and outboard panels at Y_0 = 312.50. Each panel was capable of independent deflection. Both of the left hand elevon panels and the bodyflap were instrumented with hinge moment beams. The right hand wing panel was instrumented with two wing bending gages and a wing torsion gage.

The right hand wing panel was also instrumented with 42 upper and lower wing surface pressures at two spanwise locations. The inboard station was at $Y_0 = 204$ ($\eta = 0.436$) and had 25 pressures while the outboard was at 361 ($\eta = 0.771$) and had 17 pressures.

The external tank (ET), solid rocket boosters (SRB), attach hardware, ventlines and simulated fairings were constructed of aluminum and 17-4 steel. No pressures or forces were recorded on these components.

The forward attach fairing or wedge was removable as was the rear attach crossbeam. The forward wedge covered a 33.3-inch diameter strut which attached the Orbiter to the ET. A later strut configuration which was tested was only 11.3 inches in diameter.

CONFIGURATIONS INVESTIGATED (Continued)

The following letter/number designations were used to describe the Orbiter and integrated launch vehicle configurations:

Symbol	<u>Definition</u>
01	Orbiter, B_{26} C_9 M_7 F_7 W_{116} E_{37} V_8 R_5
т ₁₂	External tank (ET)
s ₁ .	Solid Rocket boosters (SRB), S ₁₂ N ₄₁
P ₂ .	SRB fairings, PS_1 , PS_2 and PS_3
P8	ET Components and Fairings - PT ₁ , PT ₂ , PT ₃ , AT ₉ , AT ₁₂ , AT ₁₃ , AT ₁₄ , AT ₂₇ , FL ₁ , FL ₂ , and FR ₆
P ₉	Same as P ₈ except the rear attach crossbeam (FR ₆) is removed
P ₁₀	Same as P_8 except the forward attach wedge (AT27) fairing is removed exposing the attach strut (AT $_{15}$) and FR $_6$ is installed
P ₁₁	Same as P ₉ except the diameter of the forward attach strut (AT ₁₅) is reduced to 0.170 inches (model scale)

The following letter/number designations describe the individual configuration components:

Symbol |

AT ₉	Attach structure-rear SRB/ET per Rockwell Lines VL72-000106, Model dwg. SS-A01168
AT ₁₂	Attach structure-left rear ORB/ET per Rockwell Lines VL78-000050, Model dwg. SS-A01167
AT ₁₃	Attach structure-right rear ORB/ET per Rockwell Lines VL78-000050, Model dwg. SS-A01167
AT ₁₄	Attach structure-front SRB/ET per Rockwell Lines VL77-000051A, Model dwg. SS-A01168

CONFIGURATIONS INVESTIGATED (Continued)

ΑT	15	Attach structure-front ORB/ET per Model drawing SS-A01166-4, 33.3 inch diameter
ΑT	27	Attach structure-front ORB/ET per Model dwg. SS-A001255, includes ${\rm AT_{15}}$ plus wedge fairing
B ₂	6	Orbiter fuselage per Rockwell Lines VL70-000140A/B, Model dwg. SS-A00147
c ₉		Orbiter canopy per Rockwell Lines VL70-000140A/B, Model dwg. SS-A00147
E ₃	7	Orbiter full span, unswept hingeline, Grumman gapped elevons per Rockwell Lines VL70-000200, Model dwg. SS-A01256, SS- A00148
F ₇		Orbiter body flap per Rockwell Lines VL70-000200, Model dwg. SS-A01256, SS-A00147
FL	1	ET/ORB. LOX feedline per Rockwell Lines VL78-000050, Model dwg. SS-A01167
FL	2	ET/ORB. LH ₂ feedline per Rockwell Lines VL78-000050, Model dwg. SS-A01167
FR	6	ET/ORB rear attach structure cross member per Rockwell Lines VL78-000062B, Model drawing SS-A01256
M ₇		Orbiter OMS/RCS pods per Rockwell Lines VL70-000145 Model dwg. SS-A00147
N ₂	8	Orbiter OMS engine nozzles per Rockwell Lines VL70-000145, Model dwg. SS-A00147
N _A	1	SRB engine nozzles per Rockwell Lines VL77-000036A, Model dwg. SS-A01168
PS	71	SRB electrical tunnel fairing per Rockwell Lines VL77-000036A, Model dwg. SS-A01168
PS	2	SRB attach ring per Rockwell Lines VL77-000036A, Model dwg. SS-A01168
PS	3	SRB separation rocket fairing per Rockwell Lines VL77-000036A, Model dwg. \$S-A01168

CONFIGURATIONS INVESTIGATED (Concluded)

PT	ET, LOX ventline fairing per Rockwell Lines VL78-000031A, Model dwg. SS-A01167
PT ₂	ET ₁₂ LOX feedline per Rockwell Lines VL78-000031A, Model dwg. SS-A01167
PT ₃ .	ET ₁₂ LH ₂ feedline per Rockwell Lines VL78-000031A, Model dwg. SS-A01167
R ₅	Orbiter rudder per Rockwell Lines VL70-000146A, Model dwg. SS-A00115
s ₁₂	SRB per Rockwell Lines VL77-000036A, Model dwg. SS-A01167
T _{12'}	ET per Rockwell Lines VL78-000041B, Model dwg. SS-A01167
ν ₈	Orbiter centerline vertical tail per Rockwell Lines VL70-000146A, Model dwg. SS-A00148
W116	Orbiter double delta wing per Rockwell Lines VL70-000200, Model dwg. SS-A00148

TEST FACILITY DESCRIPTION

The Rockwell International Trisonic Wind Tunnel is an intermittent blow down facility with a 7' x 7' tandem test section capable of testing force, duct, pressure, and flutter models at Mach numbers from 0.1 to 3.5.

Two synchronous motor-driven centrifugal compressors, operating in series, supply dry air at a rate of 40 lb/sec. to eight storage spheres having a total volume of 214,000 cu. feet. The air is dried to a moisture content of .0001 lb. or less of water per lb. of dry air (approx. -35°F dew-point) and stored at a pressure of ten atmospheres. Flow from the air storage spheres is regulated by a servo controlled valve. The eight foot diameter valve opens within two seconds to control and stabilize the settling chamber at a preselected pressure.

Downstream of the settling chamber is a fixed nozzle which provides a transition from the circular cross-section of the settling chamber to the rectangular cross-section of the variable nozzle. Two seven foot wide steel plates, supported between parallel walls by hydraulic jacks, form the floor and ceiling of the flexible nozzle section. Changes in nozzle contours to produce variations in Mach number are accomplished by means of these jacks and require 30 to 40 minutes to complete.

Two test sections, for supersonic, transonic, and subsonic testing are 7 ft. wide by 7 ft. high and are permanently installed in a tandem arrangement. The standard supersonic test section (for testing at Mach numbers greater than 1.3) is in the downstream end of the flexible nozzle. The test section for subsonic and transonic operation is located downstream

TEST FACILITY DESCRIPTION (Concluded)

in the porous wall?area. An access door to the test area is located in the avariable diffuser.

The variable diffuser downstream of the porous wall area may be adjusted to provide subsonic Mach number control, to generate transonic Machinumbers, and to minimize start time for supersonic testing with models having high tunnel blockage.

An equivalent 5° conical expansion angle is provided in a fixed diffuser which completes the basic tunnel circuit. Downstream of the diffuser is a sound abatement muffler building where the air is exhausted to the atmosphere.

DATA REDUCTION

The elevon panel hinge moments, bodyflap hinge moments and wing bending/torsion moments were measured by individual strain gage beams.

The data reduction procedures are as follows:

(1) Compute inboard elevon hinge moment coefficient

$$c_{h_{eI}} = \frac{H_{eI}}{qS_{e}C_{e}}$$
, $H_{eI} = \text{inboard hinge moment, in-lbs}$ $q = \text{tunnel dynamic pressure, psf}$ $S_{e} = \text{elevon reference area, ft}^{2}$ $C_{e} = \text{elevon reference chord, inches}$

(2) Compute outboard elevon hinge moment coefficient

$$C_{h_{e0}} = \frac{H_{e0}}{qS_{e}C_{e}}$$
 $H_{e0} = \text{outboard hinge moment, in-lb}$

(3) Compute total elevon hinge moment coefficient

$$c_{h_{eT}} = c_{h_{eI}} + c_{h_{eO}}$$

(4) Compute body flap hinge moment coefficient

$$C_{h_{BF}} = \frac{H_{BF}}{qS_{BF}C_{BF}}$$
, $H_{BF} = body \hat{f}lap hinge moment, in-lb $S_{BF} = body flap reference area, ft^2$
 $C_{BF} = body flap reference chord, inches$$

(5) Compute the right wing panel bending moment and coefficient

$$N_W = \frac{(^{m}1 - ^{m}2)}{a_m}$$
, lbs $m_1 = \frac{(^{m}1 - ^{m}2)}{in-lbs}$ outboard wing bending gage moment, $m_2 = \frac{(^{m}1 - ^{m}2)}{moment}$, in-lbs

DATA REDUCTION (Continued)

$$B_W = \frac{m_2 + N_W}{2 + N_W}$$
 (d), in-lbs $S_W = \text{wing reference area, ft}^2$

$$C_{B_W} = \frac{B_W}{qS_WB_{REF}}$$

$$a_m = \frac{B_{REF}}{distance from m_1 to m_2}$$

$$d = \frac{distance from m_2}{distance from m_2 to exposed wing root chord, inches}$$

(6) Compute the right wing panel torsion moment and coefficient

$$T_W = m_3$$
, in-lbs $m_3 =$ wing torsion gage moment, in-lbs
$$T_{W_{1307}} = T_W + N_W (e_m) \qquad e_m =$$
 distance from m_3 to torsion reference center $(X_0 = 1307)$, inches
$$\bar{c}_{T_{W_{1307}}} = \frac{T_{W_{1307}}}{qS_W\bar{c}} \qquad \bar{c} =$$
 wing reference chord, inches

(7) Compute right wing panel leading edge, upper surface, lower surface and net pressure coefficients for the inboard chordwise location (n = 0.436)

$$C_{P_{LEi}} = \frac{P_{W_{LEi}} - P_{O}}{q} \quad i = 1$$

$$C_{P_{WUi}} = \frac{P_{W_{Ui}} - P_{O}}{q} \quad i = 2 \rightarrow 13$$

$$C_{P_{WLi}} = \frac{P_{W_{Li}} - P_{O}}{q} \quad i = 14 \rightarrow 25$$

$$C_{P_{Ti}} = C_{P_{WUi}} - C_{P_{WLi}} \quad \text{e.g., } i = (2 - 14), (3 - 15), \text{etc.}$$

(8) Compute right wing panel leading edge, upper surface, lower surface and net pressure coefficients for the outboard chordwise location ($\eta \approx 0.771$)

DATA REDUCTION (Continued)

$$\begin{split} & c_{P_{LEi}} = \frac{P_{W_{LEi}} - P_{O}}{q} & i = 26 \\ & c_{P_{WUi}} = \frac{P_{W_{Ui}} - P_{O}}{q} & i = 27 \rightarrow 34 \\ & c_{P_{WLi}} = \frac{P_{W_{Li}} - P_{O}}{q} & i = 35 \rightarrow 42 \\ & c_{P_{Ti}} = c_{P_{WUi}} - c_{\hat{P}_{WLi}} & e.g., i = (27-35), (28-36), etc. \end{split}$$

Angle of attack and angle of yaw were corrected for sting deflection. Gage interactions for wing bending and torsion were also applied.

The following reference dimensions and constants were used during this test:

Symbol	<u>Definition</u>	Model Scale	Full Scale
S_W	wing reference area, ft ² /	0.6053	2690.00
B _{REF}	wing span, in	14.0502	936.68
c	wing MAC, in	7.1220	474.80
S _e	elevon reference area, ft ²	0.0473	210.00
С _е	elevon reference chord, in	1.3605	90.70
S_{BF}	body flap reference area, ft ²	0.0304	135.60
c_{BF}	body flap reference chord, in	1.2150	81.00
L REFX	Orbiter body length, in	19.355	1290.30

DATA REDUCTION (Concluded)

LREFY	wing semispan, in	_7.0251	468.34
	Gage Constants		
a _m	distance from m_1 to m_2 , in	0.6737	-
d	distance from m_2 to exposed wing root chord, in	0.9448	~
e _m	distance from m ₃ to torsion reference point, in	0.7050	-

TEST: IA70 (TWT	282)		DATE: 4 June 74
	TEST CON	DITIONS	
MACH NUMBER	REYNOLDS NUMBER (per foot)	DYNAMIC PRESSURE (pounds/sq. inch)	STAGNATION TEMPERATURE (degrees Fahrenheit)
0.90	6.08	6,65	50-70
1.12	6.82	8.45	50→70
1.24	7.25	9.19	50→70
1,50	7.56	10.28	50→70
			,
BALANCE UTILIZED:	TASK MK XXVII Dı	ımmy. 1.5° Dia.	
	CAPACITY	ACCURACY:	COEFFICIENT TOLERANCE
NF			
SF			7.5
AF			
PM			,
RM			
YM			
COMMENTS			4
COMMENTS			
RES			

	ATA SET	CONFIGURATION	sc	нD. В	PARA	METE δ02	RS/V	SOA	NO. OF	M/ ØBF	0.90	BERS (OR ALT	I.24	PENDENT VAF	The second second	
2	F7001	Φ,	A	Ō	0	0	0	0	17043	0	15		16			
		Φ1 T12 S1 P2 P8	1	Ī	\Box	0	0				19	18	17	58	-	
	<u></u> ග3			П		+4	+4				20	21	22	59		
	004					+8	+8				25	24	23	- 6O		
	005	•		П	T	+12	+12				26	27	28	61		
	006				+4	+12	+12	+4			31	30	29	62		
L	007					+8	+8				32	33	34	63		
	800					+8	+8				35			()		
	009					+4	+4				36	37	. 38	176		
	010					0	0	V			41	40	39	1		
	OH				+8	0	0	+8			42	43	44	1		
	012					+4	+4				47	46	45	1		
	013					+8	+8				48	49	50	177		
	014					+12	+12	. 1			53	52	51			
	015				-4	+12	+12	-4						54		
	016					+8	$\dot{\varphi}$							55		
	017					+4	+4							56		
	018	Y	Y	Ì	Y	0	0	Y		7				57		
-	EØ. K		HBF.		25 GB W	,	31 \T	v I	37	·	43	49	55	MACH,	67 IALPHA	75

PRESSURE DATA IN DATASETS 43 thru 68

DATA SET	CONFIGURATION						ALUES		-				NDEPENDENT		
IDENTIFIER		ļα	- Parket State of Sta	130		100	u Čancanii i dan da ka	RUNS	SBE	-	0.90	1.12	1.24	1.50	-
	0, T125, P2P8	A	0	-8		+8	-8	<u> </u>	0					64	
020		\coprod	Ш	-8	 	H2		<u> </u>						65	
021			Y	-4	+8	+8	-4	<u> </u>						66	
055			+8											67	
023			-4											68	
024	,		-8	V	7	-								69	
025		П	4 8	0	+12	+12	0						71	`, -	
026		\prod	+4	1	T	1							164		
027			14							 			163		
028			-8							 	<u> </u>		70		
029			-8	-		-	4						162		
030				+4			+4			 -	75	72	104		
031			<u>)</u> လ	1			1				74	73			
032		}- †	ر م	-}-	+4	+4							170		
C33			-0 -0 -0	-9	+4									_	
034				+8			48						171		
		H		+8 0	+8	+8	+0 +8						173		
C35		47			10								172		
036			+8	0	0	0	0						166		
HEØ. C	HEI, CHET, CH	- I		25 C (2)	,	31		37		43	49	55	_ 61	67	7! A
17 L	HEI. ICHET. CH β $\alpha(\Delta) = -8$			GBN		CTY	_	ببل		بيا	<u> </u>		MACH SOZ = L	ALPHA I) IDVAR (I H INBO	

23

1E21: TH	70 TWT 282]	I	DATA	A SE	r/Ru	N NU	MBER			I SUMMA		: 29 M/		
DATA SET	CONFIGURATION	sc a					δε4	4 (16	δBF		O.90	R ALTERNATE IN	1.24	1.50	
RF7037	OITI2SIP2Pa	A	-8	0	0	0	0		0				165		
038	Po	П	0										167		
037	Pio							,					169		
040	Pii		1										174		
041	PII		₹ 8									175			
042	Φ1 T12 S1 P2 P8		0						+10				168		
043			₩8						0		137	145	76	117	ST F
044			+4								136	144	79	116	RUN
045			0								138	143	78	115	NUMBE
046			-4	,						:	139	142	80	114	BER
C47		П	-8	1	1	1	1				140	141	77	113	s
048		П	+8	+4	+4	+4	+4				94	101	132	108	
049			14				1				135	100	(3)	109	
050			0								95	99	130	110	
051		П	-4								134	98	129	111	
052			-8	1	1	1	1				96	97	133	112	_
053		П	+8	+8	+8	+8	+8				150	159	149	102	
V 054		V	44	48	8+	34	48				151	158	125	124	
1 7	13 19			25		31		37		43	49	5 5	61	67	75 76
CHEØ, C	HEI, CHET, CH	BF	لب	CBV	۲.,	CI		ىل		ببا			MACH.	ALPHA	لملم
a or	β $Q(\Delta) = -$	8	to	+	<u>8:</u> ,	δ	(= Z	CENT	s 			LH OUTED	Sez L	I) IDVAR (2) H INBD CH CUTBD	NDV

24

DATA SET	CONFIGURATIO	/ Poss	SCH	D. PAR	AMET	ERS/V	ALUES	NO OF	MACH	TON SUMMAR	ALTERNATE I		VARIABLE)	
	A 7. C. C. D.			β <i>δ</i> ει				RUNS		0.90	1.12	1.24	1.50	
2F7 055	Φ, Tiz Si PaPi	3 /	 		1+0	140	+8	ļ	0	152	157	126	103	
056				4			11	ļ		153	156	128	123	
057				8	1	V	\ \\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\			154	155	148	104	
058				8	+15	+12	+12			93	86	85	118	
<u> </u>			4	4						161	87	84	119	
060					Ш					92	88	83	120	
061				4						160	89	81	121	
062			_	8	1	٧	V			91	90	82	122	
063		[+	8-4	0	-4	-4			5			107	
064				>TT	l i	1							106	
065	Ÿ		-:	8 V	V	V		ĺ			 		105	
066	DITI2SIP2P	9	7	3 +8	+8	+8	48					127	1.00	
067	P		T	0	0	0	0					146		
068		10	Ī	7 0	0	0	0					147		
•		'	†									19(7)		
			\dagger									-		
			┪					\dashv						
			1										_	
	12	10				i								
HEIO, C	HET, CHET,	19 CHBF	=	CBW		31 CTV	J.	37	43	49	55	61 AAA (2.1)	67 .A.(D.).(A	75
								ENTS	4-4-1-1-1	<u> </u>		MACH	ALPHA	
α OR , SCHEDUL		<u>-8</u>	to	+8	<u>, ^</u>	<u> </u>	2°		 -	<u> १८७</u> स = ६७०		δe2 = LH δe4 = RH	NBO	

TABLE III. - MODEL DIMENSIONAL DATA

MODEL COMPONENT	F: Attach Struct	ture AT9		
GENERAL DESCRI	PTION: Aft SRB/	ET attach	structure (3 member	structure)
Model Scale: (0.015			
DRAWING NO:				
DIMENSIONS:	MEMBER		FULL SCALE	MODEL SCALE
	# 1.	x_{B}	1515	22.725
		Y _B	<u>+</u> 56	<u>+</u> .840
		z_{B}	50	.750
		x_{T}	2058	30.870
		$\mathbf{Y_{T}}$	<u>+</u> 158	2.370
		$z_{ m T}$	450	6.75
	#2	x_B	1515	22.725
		$\mathtt{Y}_{\mathtt{B}}$	<u>+</u> 76	± 1.140
		z_{B}	18	. 270
		$\mathtt{X}_{\mathbf{T}}$	2058	30.870
		$\mathtt{Y}_{\mathbf{T}}$	160	2.400
		$z_{ m T}$	445	6.675
	#3	x_{B}	1515	22.725
	""	Y _B	± 56	± .840
		z _B	- 50	75 0
		χ _T	2058	30.870
		Y _T	± 158	+ 2.370
		Z_{T}	350	5.250

Diameter of Members: TBD

TABLE III. - Continued.

MODEL COMPONENT:	Attach Struct	ure AT,	2	
		•	/ET sttach structure	(2 member structure)
Model Scale: 0.03	15			
DRAWING NO. VL	78-000050			
commension:	MEMBER		FULL SCALE	MODEL SCALE
	#1	x _o	1303	19.545
		Yo	96	_1.440
		z_{o}	258	3.870
		$x_{\mathtt{T}}$	1859	27.885
		$\mathbf{Y}_{\mathbf{T}}$	115	1.725
		7_{T}	510	7.650
	#2	Хo	1317	19.755
		Yo	-96	1.440
		7 ₀	258	3.870
		· X _T	2058	30.870
		$\mathbf{Y}_{\mathbf{T}}$	115	1.725
		Z ೡ	510	7.650

Diameter of Members: TBD

TABLE III. - Continued.

MODEL COMPONENT: Attach Structure AT13

GENERAL DESCRIPTION: Right rear orbiter/ET attach structure (3 member structure)

Model Scale: 0.015

MODEL NO. VL78-000050

DIMENSION:	MEMBER		FULL SCALE	MODEL SCALE
	#1	x_o	1313	19.695
		Yo	+96	1.44
		7 ₀	258	3.870
		x_{T}	1859 ,	27.885
		$\mathbf{Y}_{\mathbf{T}}$	_115	-1.725
		z_{T}	<i>-5</i> 10	7.650
				,
	#2	X_{o}	1317	19.755
		Yo	+96	1.440
		7 ₀	258	3.870
		$\mathbf{x}_{\mathbf{T}}$	2058	30.870
		$\mathtt{Y}_{\mathbf{T}}$	115	1.725
		z_{T}	510	7.650
			,	
	./3	Xo	1317	19.755
		Y_{o}	96	1.440
		z _o	258	3.870
		$x_{\mathbf{T}}$	2058	30,870
		$\mathbf{Y}_{\mathbf{T}}$		0
		$7_{ m T}$	566	8.490

Diameter of Members: TBD

TABLE III. - Continued.

MODEL COMPONENT: Attach Struct	ture AT		
GENERAL DESCRIPTION: Forward	1-4	ach structure	
oddistan besonii i on t <u>i oi war a</u>	CALLY INC.	T	
Model Scale: 0.015			
DRAWING NO: VL77-000051A			
DIMENSION:	•	FULL SCALE	MODEL SCALE
	x_B	404	6.060
	YB	<u>+ 177</u>	2.655
	z _B ,	0	0
	x_{T}	947	14.205
	$\mathtt{Y}_{\mathtt{T}}$	<u>± 167</u>	2.505
	$z_{ m T}$	400	6.000

TABLE III - Continued.

MODEL COMPONENT: ATTACH STRUCTURE - AT15.

GENERAL DESCRIPTION: Forward attach structure between the orbiter and external tank. Modified to accept Rockwell International Trisonic Wind Tunnel starting loads.

MODEL SCALE: 0.015

MODEL DRAWING NO:: SS-A01166-4

DIMENSIONS:		FULL SCALE	MODEL SCALE
Strut centerline:	x_{o}	391.00	5.865
	Yo	0.0	0.0
	$\mathbf{x}_{\mathbf{T}}$	998.87	14.980
	$\mathtt{Y}_{\mathbf{T}}$	0.0	0.0
Strut diameter, In.		33.33	0.500

TABLE III. - Continued.

MODEL COMPONENT: ATTACH STRUCTURE - AT27

GENERAL DESCRIPTION: Forward attach structure between the orbiter and external tank. Same as ${\rm AT}_{15}$ except for addition of a wedge fairing fore and aft of the strut.

MODEL SCALE: 0.015

DRAWING NO.: SS-A01255

DIMENSIONS:		FULL SCALE	MODEL SCALE
Wedge Leading Edge:	x_0	291.00	4.365
	Yo	0.0	0.0
	$X_{\underline{T}}$	1032.00	15.480
	YŢ	0.00	0.00
Length of Fairing, In.		200.00	3.000
Maximum width, In.		37.53	0.563
Leading Edge Radius, In.		4.00	0.060

*REVISED 4/24/74 TABLE III. - Continued.

MODEL COMPONENT. BODY - B26		
GENERAL DESCRIPTIONConfiguration :	L40A/B Orbiter	Fuselage
NOTE: B26 is identical to B24 except up	nderside of fus	selage has been
refaired to accept W ₁₁₆ .		
MODEL SCALE: 0.015 MODEL DI	RAWING: SS-AOC	0147, RELEASE 12
DRAWING NUMBER VL70-000143B, -000200), 000205, - 00	06089, -000145,
DIMENSIONS		MODEL SCALE
*Length (OML: Fwd Sta. $X_0=235$)-In *Length (IML: Fwd Sta. $X_0=238$)-In.		
* Max Width (@ X = 1528.3) - In.	264.0	3.960
Max Depth (@ $X_0 = 1464$) - In.	250.0	3.750
Fineness Ratio		
Area - Ft ²		
Max. Cross-Sectional	340.88	0.077
Planform		
Wetted		
Base		

TABLE III. - Continued.

MODEL COMPONENT : Canopy (C9)		
GENERAL DESCRIPTION :Configuratio	n 140 A/B Orbiter	Fuselage
	•	7-71
		*
Model Scale = 0.015	Model Dra	wing No. SS-A00147
DRAWING NUMBER: VL70-000143A	······································	
•		
DIMENSIONS:	FULL SCALE	MODEL SCALE
Length (Xo=434.643 to 578), 177.	143.357	2.150
Max Width (@ X ₀ =513.127), in	152.412	2.286
Max Depth (@ Xo=485.0), 17	[,] 25.000	0.375
Fineness Ratio	·	***************************************
Área	Activities and Company of the Compan	
Max. Cross-Sectional		
Planform		
Wetted		
Base	•	

MODEL COMPONENT: ALTERNATE SLOTTED FLEVON - E37			
GENERAL DESCRIPTION: Configuration 140A/B O	rbiter Elevon.	-	
E ₃₇ is a slotted version of F ₂₆ . Data is fo	or one side.		
MODEL SCALE: 0.015 MODEL MODEL	DRAVING: SS-A001	47, RFIEASE 12	
DRAWING NUMBER: VL70-000200, -0060 Fig. 4A of SAS/AEI			
<u>DIMENSIONS:</u>	FULL-SCALE	MODEL SCALE	
Area - Ft ²	210.00	0.0473	
Span (equivalent) - In.	349.20	5.238	
Inb'd equivalent chord In.	118.00	1.770	
Outb'd equivalent chord	55.19	0.828	
Ratio movable surface chord/ total surface chord			
At Inb'd equiv. chord ·	0.2096	0.2096	
At Outb'd equiv. chord	0.4004	0.4004	
Sweep Back Angles, degrees			
Leading Edge	0.00	0.00	
Trailing Edge	- 10.056	- 10.056	
Hingeline	0.00	0.00	
Area Moment (Normal to hinge line) Ft ³	1587.25	0.00536	
$Y_0 = 311.0 (4.665)$	11		
$X_{0} = 1427.2 (21.408)$ $X_{0} = 128.93 (1.934)$			
X _o 1501.97 (22.533 Y _o 131.145 (1.96)	7)	34	

MODEL COMPONENT BODY FLAP F		
GENERAL DESCRIPTIONConfiguration	140A/B Orbiter B	ody Flap
-		
		
MODEL SCALE: 0.015	MODEL DRAVING:	SS-A00147, RELEASE 12
DRAWING NUMBER _VL70-000140A, VL70-	000145, VL70-0002	
l 2		
DIMENSIONS	FULL SCALE	MODEL SCALE
Length $(Y_0=1520 \text{ to } X_0=1613)$ -	In. 93.000*	1.395
Max Width - In.	262.000	3.930
Max Depth $(X_0 = 1520) - In.$	23.000	0.345
Fineness Ratio		
Area - Ft ²		
Max. Cross-Sectional		
Planform	142.6	0.0321
Wetted		
Base	41.847	0.0094

*Model dim. measured from Model Sta. 15.20

MODEL COMPONENT: FEEDLINE - FL1

GENERAL DESCRIPTION: LOX feedline between ET and Orbiter.

MODEL SCALE: 0.015

DRAWING NO.: VL78-000050

DIMENSIONS:		FULL SCALE	MODEL SCALE
Centerline at:	$\mathbf{x}_{\mathbf{T}}$	2063.5	<u>3</u> 0.953
	$\mathbf{Y}_{\mathbf{T}}$	+ 70.0	+ 1.050
	x_o	1440.6	21.609
	Yo	70.0	1.050
Diameter		18.5	0.278

MODEL COMPONENT: FEEDLINE - FL2

GENERAL DESCRIPTION: LH_2 feedline between ET and Orbiter.

MODEL SCALE: 0.015

DRAWING NO.: VL78-000050

DIMENSIONS:		FULL SCALE	MODEL SCALE
Centerline at:	$\mathbf{x}_{\mathbf{T}}$	2063.5	30.953
	$\mathtt{Y}_{\mathbf{T}}^{}$		1.050
	x _o	1330.5	19.958
	Yo	- 70.00	1.050
Diameter		18.5	0.278

MODEL COMPONENT: REAR ATTACH STRUCTURE FAIRING - FR6

GENERAL DESCRIPTION: Rear ET/Orbiter attach structure cross-member or beam fairing used in conjunction with ${\rm AT}_{12}$, ${\rm AT}_{13}$, ${\rm FL}_1$ and ${\rm FL}_2$. Includes diagonal strut.

MODEL SCALE: 0.015 DRAWING NO: VL78-000062B, SS-A0	1256		
Dīmensions:		FULL SCALE	MODEL SCALE
Leading Edge centerline at:	$\mathbf{x_T}$	2036.67	30.550
	$\mathbf{Y}_{\mathbf{T}}$	0.00	0.00
	z_{T}	183.00	2.745
Maximum length, In.		64.00	0.960
Maximum width. In.		190.00	2 850

MODEL COMPONENT . OMS Pod (M7)			
GENERAL DESCRIPTION: Configuration 140 A/B Orbiter OMS-Pod			
,			
Model Scale = 0.015	Model Drawing	No. 55-A00147	
VL70-000140A VL70-000145			
DIMENSIONS:	FULL SCALE	MODEL SCALE	
Length(OMS Fwd Sta Xo=1233.0) -IN	327.000	4.905	
Max Width (@ X ₀ =1450.0) - IN.	94.5	1.418	
Max Depth (@ X ₀ =1493.0) - IN.	109.000	1.635	
Fineness Ratio	,	**************************************	
Area			
Max. Cross-Sectional		•	
Planform	*************************************		
Wetted			
Base	•	•	

MODEL COMPONENT: NOZZLES - (N 28)		•	~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
GENERAL DESCRIPTION: Configuration	n 140 A/B Orbite	er CMS Nozzle	
	ı		
MODEL SCALE = 0.015		Model Drawin	ng No. SS-A00147
DRAWING NO	145		
DIMENSIONS		FULL SCALE	MODEL SCALE
Mach, No.	i		
Length \sim in.			•
Gimbal Point to Exit Plane	.		
Throat to Exit Plane		 , ,	
Diameter~in.			
Exit		***************************************	
Throat		·	
Inlet		-	
Area \sim ft ² .			
Exit			
Throat			
Gimbal Point (station)∼in.			
x		1518.00	22.77
Y		<u>+</u> 88.0	1.32
Z'		492.0	7.38
Null Position~deg.			
Pitch/		159 491	15° 491
Yaw	40 [,] .	12% 17%	12° 17'

MODEL COMPONENT: NOZZLES - N41		
GENERAL DESCRIFTION: Configuration 4 BSRM Nozz	les	
		·
2000		
MODEL SCALE = 0.015 VL72-000088E		
DRAWING NO. <u>VL77-000036A</u>		•
DIMENSIONS	FULL SCALE	MODEL SCALE
Mach No.		•
Length ~ in.		
Gimbal Point to Exit Plane	141.3	2.120
Throat to Exit Plene		2
Diameter~in.		
Exit	141.3	2.120
, Throat	•	
Inlet		
Area~ft ² .		
Exit	108.89 95	0.0245
Throat		
Gimbal Point (station)~in.		
x	1796.15	26.942
Y	±243.0	<u>+</u> 3.645
. Z	400.0	6.0
Null Position~deg.		
Pitch	0°	0°
Yen	0°	0°
FS of Nozzle Exit Plane (X _T) IN. 41	21,8I	37.260

MODEL COMPONENT: SRB Protuberance PS1		
DESCRIPTION: Electrical tunnel fairing	on top of each SRB	and the second s
MODEL SCALE: 0.015		
:DRAWING NO: <u>VL77-000036A</u>	{ ·	
¿DIMENSION: (Data for 1 of 2)		
	FULL SCALE	MODEL SCALE
Leading edge at XB	<u>467</u>	7.001
${\tt C}$ of tunnel ${\tt Y}_{\sf B}$	0	
Trailing edge at $X_{\overline{B}}$	1820	27.30
Height, In.	3	045
Width, m.	6	.090
ALE, deg.	72	72

MODEL COMPONENT: SRB Protuberance 1	PS2	
DESCRIPTION: SRB/ET attach ring		
and the second control of the second control		والمراقبة المراقبة والمراقبة
MODEL SCALE: 0.015		
DRAWING NO.: VL77-000036A		
DIMENSIONS: (Data for 1 of 2)		
	Digr coard	Nobel costs
	FULL SCALE	MODEL SCALE
c at X _B	1515	22.725
Width, In.	10	15
Heighth, in.	10	15

MODEL COMPONENT: SRB Protuberance PS3		
DESCRIPTION: Separation rocket fairing on ea	ach SRB nozzle sh	roud located
30% inboard from top centerline.		TOUR TOURS
MODEL SCALE: 0.015		
DRAWING NO.: VL77-000036A		
DIMENSIONS: (Data for 1 of 2)		
	FULL SCALE	MODEL SCALE
Leading edge at XB	1796	26.940
Trailing edge at XB	1889	28.335

Radial location is 30° inboard from top centerline.

MODEL COMPON	ENT: ET	Protuberance	PT1		
DESCRIPTION:	LOX Vent Li	ne Fairing on	Tank T12	Nose	······
MODEL SCALE:	.015				
DRAWING NO	VL78-000031A		-		
				FULL SCALE	MODEL SCALE
DIMENSIONS:	Leading edg	e at \mathtt{X}_{T}		321	4.815
		$\mathtt{Y}_{\mathbf{T}}$			0
	Trailing ed	ge at X _T		947	14.205
		'Y _T '		_70	1.053

MODEL COMPONENT: ET Protuberance PTo					
DESCRIPTION: LOX feed lines on vehicle 4 tank	secured to tank	by brackets			
with 50-inch spacing					
MODEL SCALE: 0.015					
DRAWING NO. <u>VL78-000031</u> A					
	FULL SCALE	MODEL SCALE			
DIMENSIONS: Leading edge at XT	947	14.205			
$\mathtt{Y}_{\mathbf{T}}$	<u>-70</u>	<u>-1.053</u>			
Trailing edge at XT	1330	19.950			
$\mathtt{Y}_{\mathbf{T}}$	<u>-70</u>	1.053			
Bracket spacing from $X_T = 997, 171$.	50	•75			

MODEL COMPO	NENT: ET Protuberance P	Т3			
	: LH2 feed line on vehi		secured to	tank by	brackets
with 50-incl	n spacing.				
MODEL SCALE	:0.015	,,			
DRAWING NO.	VL78-000031A				
•					
			FULL SCALE	<u>M</u>	ODEL SCALE
DIMENSIONS:	Leading edge at X _T		947		14.205
	Ϋ́m	ı	70		1.053
	1	· ;			!
	Trailing edge at \mathbb{Z}_{T}	1	1330	• •••	19,950
	$\dot{\dot{\mathtt{Y}}}_{\mathbf{T}}$,	70		1.053
	Bracket spacing from % =	= 097 ata	. 50		•75
	obecor	/// / / Li			بريد سيوند

TABLE III. - Continued.

MODEL COMPONENT: RUDDER - R5		
GENERAL DESCRIPTION: Configuration 14	OA/B Orbiter Rudder	•
	-	
Model Scale = 0.015	Model Drawing No.	SS-A00148
DRAWING NUMBER: VL70-000146A VL70-000095	· ·	
DIMENSIONS:	FULL-SCALE	MODEL SCALE
Area, ft ²	100.15	0.0225
Span (equivalent), in	201.0	3.015
Inb'd equivalent chord, in	91.585	1.374
Outb'd equivalent chord, in	50.833	0.762
Ratio movable surface chord/ total surface chord		
At Inb'd equiv. chord	0.400	0.400
At Outb'd equiv. chord	0.400	0.400
Sweep Back Angles, degrees		
Leading Edge	34.83	34.83
Tailing Edge	26.25	26.25
Hingeline	34.83	34.83
Area Moment (Normal to hinge line), (Product of Area and Mean Ch		0.00206
* Mean Aerodynamic Chord, in	73.2	1.098

MODEL COMPONENT: BOOSTER SOLID	ROCKET MOTOR - (512)	
GENERAL DESCRIPTION: Configurati per Rockwell Lines VI.77-000036A	on 3A, Data for (1) of (2	2) sides,
.Model Scale = 0.015		
	000088D 000036A	
DIMENSION:	FULL SCALE	MODEL SCALE
Length (Includes Nozzle) - IN.	1741.0	26.115
Max Width (Tank Dia) - IN.	142.3	2.135
Max Depth (Aft Shroud) - IN.	192.0	2.880
Fineness Ratio	9.06771	9.06771
Area - FT ²	. '	• •
Max Cross-Sectional	201.06193	0.0452
Planform ·		
Wetted	-	
Base		•
WP of BSRM Centerline (Z_{T}) - IN	. 400	6.000
FS of BSRM Nose (X_T) - IN.	743	11.145

MODEL COMPONENT: EXTERNAL TANK - (T12)		
GENERAL DESCRIPTION: External Oxygen Hydr	rogen Tank	
NOTE: Identical to Tll with external fuel	lines added	
!'od:1 Scale - 0.015		
VL78-00003Lx DRAWING NUMBER VL78-000041 V	В	
DIMENSION:	FULL SCALE	MODEL SCALE
Length - IN. (Nose @ $X_T = 309$)	1865	27.975
Max Width (Dia) - 1N.	324	4.86
Max Depth, in.		
Fineness Ratio	5.75617	5.75617
Areo - FT2	•	•
Max Cross-Sectional	572.555	0.1288
Planform .		
Wetted		· ~
Base		•
WP of Tank Centerline (Zp) - IN.	400.0	6.000

MODEL COMPONENT: VERTICAL - V 8.				
GENERAL DESCRIPTION: Configuration 140 A/B Orbite	r Vertical Tail			
NOIT: Similar to V5 with radius on TE upper corn	er and LE lower c	crner		
where vertical meets fuselage.				
Model Scale = 0.015 . VL70-000140A	Model Drawing	No. SS-A00148		
DRAWING NUMBER: VL70-000146A	name of the second seco			
DIMENSIONS:	FULL-SCALE	MODEL SCALE		
TOTAL DATA				
Area (Theo) Ft ²	413.253	0.09298		
Planform Span (Theo) In	315.720 1.675	4.73580		
Aspect Ratio Rate of Taper	0.507 0.40399	0.507 0.40399		
Taper Ratio Sweep Back Angles, degrees				
Leading Edge Trailing Edge	45.00 26.20	45.00 26.20		
0.25 Element Line Chords:	41.130	41.130		
Root (Theo) WP Tip (Theo) WP	268.500 108.470	4.02750 1.62705		
MAC Fus. Sta. of .25 MAC	199.80756 1463.50	2.99711 21.95250		
N. P. of .25 MAC B. L. of .25 MAC	635,522 0.00	9.53283 0.00		
Airfoil Section Leading Wedge Angle Deg	10.00	10.00		
Trailing Wedge Angle Deg Leading Edge Radius	14.920 2.00	14.920 0.0300		
Yoid Area Blanketed Area	13.17 0.00	0.00296		

TABLE III. - Concluded.

ODEL COMPONENT: Wing, W116 ENERAL DESCRIPTION: Configuration 140A/	B Orbiter Doub	ole Delta Wing
Nodel Scale = .015	,	
VL70-000140B		······································
RAWING NUMBER: VL70-000200		
DIMENSIONS:	FULL-SCALE	MODEL SCALE
TOTAL DATA		
Area, ft ² (Theoretical)		•
Planform Wetted	2690.00	0.6053
Span (equivalent), in	936.682	14.050
Aspect Ratio	2.265	2.265
Rate of Taper	$\frac{1.177}{2.200}$	1.177
Taper Ratio Diehedral Angle, degrees	$\frac{0.200}{3.500}$	3.500
Incidence Angle, degrees	0.500	0.500
Aerodynamic Twist, degrees	3.000	3.000
Toe-In Angle	0.0	0.0
Cant Angle	0.0	0.0
Sweep Back Angles, degrees Leading Edge	45 000	45 000
Trailing Edge	$\frac{45.000}{-10.056}$	45.000 -10.056
0.25 Element Line	$\frac{35.209}{35.209}$	35.209
Chords: //	400.045	
Root (Wing Sta. 0.0)	689.243	10.339
Tip, (equivalent) MAC	$\frac{137.849}{474.812}$	2.068
Fus. Sta. of .25 MAC	1136.830	7.122 17.052
W.P. of .25 MAC	290.580	4.359
B.L. of .25 MAC	182.130	2.732
Airfoil Section		2.132
Root	M <u>od. NASA</u>	<u> XXXX-64</u>
Tip EXPOSED DATA	· · · · · · · · · · · · · · · · · · ·	
Area , ft ² (Theo.)	1751.500	0.3941
Span, (equivalent), in (Theo.)	720.680	10.081
Aspect Ratio	2.059	2.059
Taper Ratio Chords , in.	0.245	0.245
Root B.P. 108	562.090	8.431
Tip	137,851	2.068
MAĊ	392.830	5.892
Fus. Sta. of .25 MAC	1185.980	<u> 17.790</u>
W.P. of .25 MAC B.L. of .25 MAC	294.300	4.415
	251.770	3.777
Cuff Data for 1 of 2 sides, Area, f	t2 113.18	1.698
L.E. intersects fus. ML @ St " " wing @ Sta.	ta. 500.00 1024.00	7.500 15.360

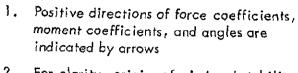
TABLE IV. - PRESSURE INSTRUMENTATION

Inboard Station Yo = 204.00			Outboard Station Y _o = 361.00		
	c = 449.0	6 in			22 in
Tap No.	X/C	Surface	Tap No.	X/C	Surface
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 22 23 24 25	0 0.030 0.048 0.085 0.177 0.274 0.402 0.565 0.760 0.808 0.857 0.905 0.953 0.030 0.048 0.085 0.177 0.274 0.402 0.565 0.760 0.808 0.857 0.905 0.953	LE upper lower	26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42	0 0.02 0.05 0.15 0.25 0.65 0.75 0.85 0.02 0.05 0.15 0.25 0.65 0.75 0.85	LE upper upper upper upper upper upper upper lower lower lower lower lower lower

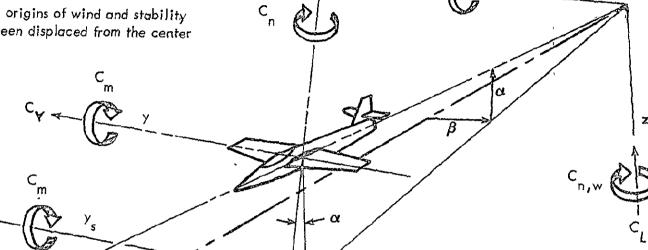
For Right Hand Wing Panel

57

Notes's

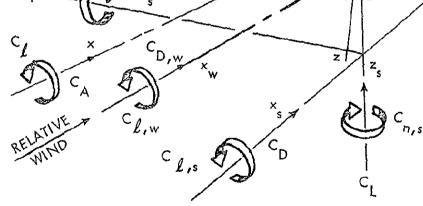


2. For clarity, origins of wind and stability axes have been displaced from the center of gravity



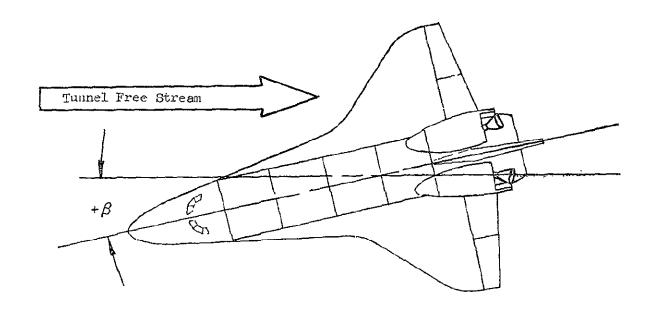
 $C_{m,w}$

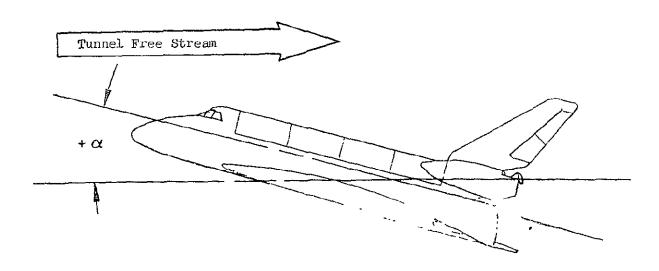
У_w



a. General

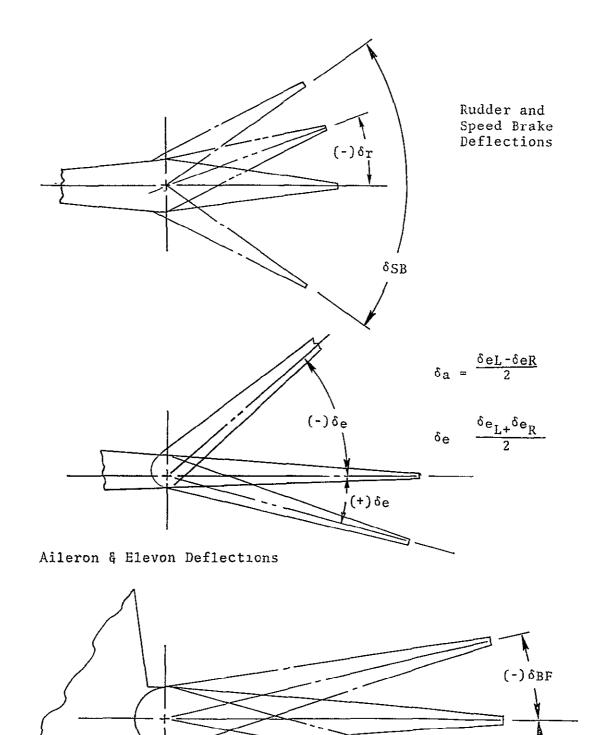
Figure 1. - Axis systems.





b. Model Attitude Definition

Figure 1. - Continued.



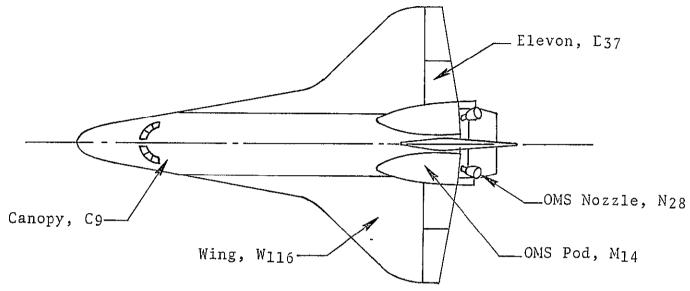
Body Flap Deflections

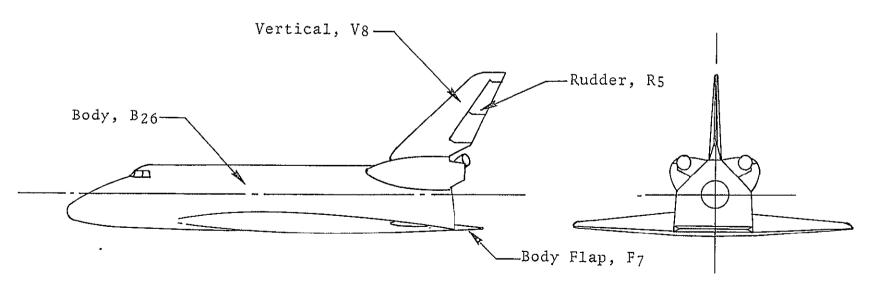
c. Sign Convention for Control Surfaces

Figure 1. - Concluded.

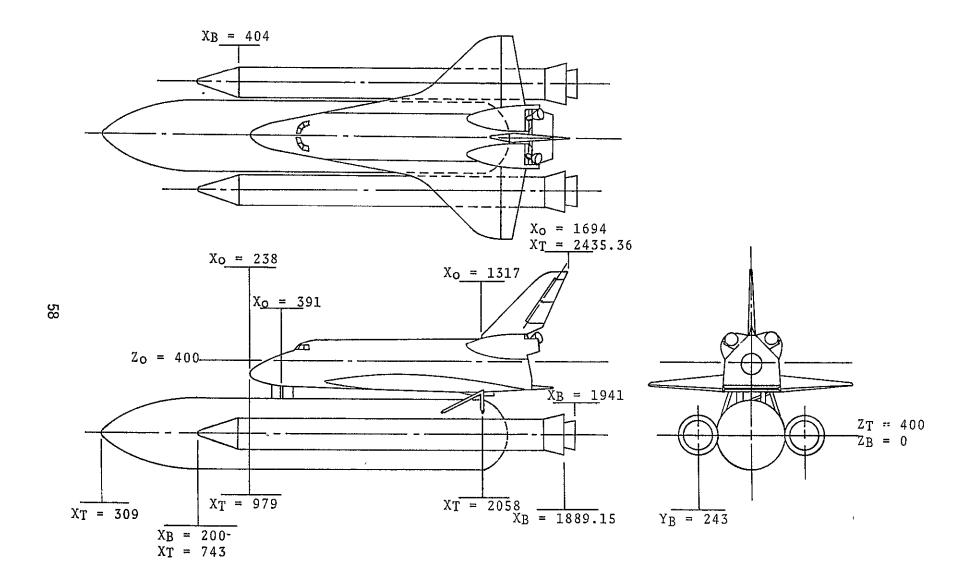
(+)δ_{BF}



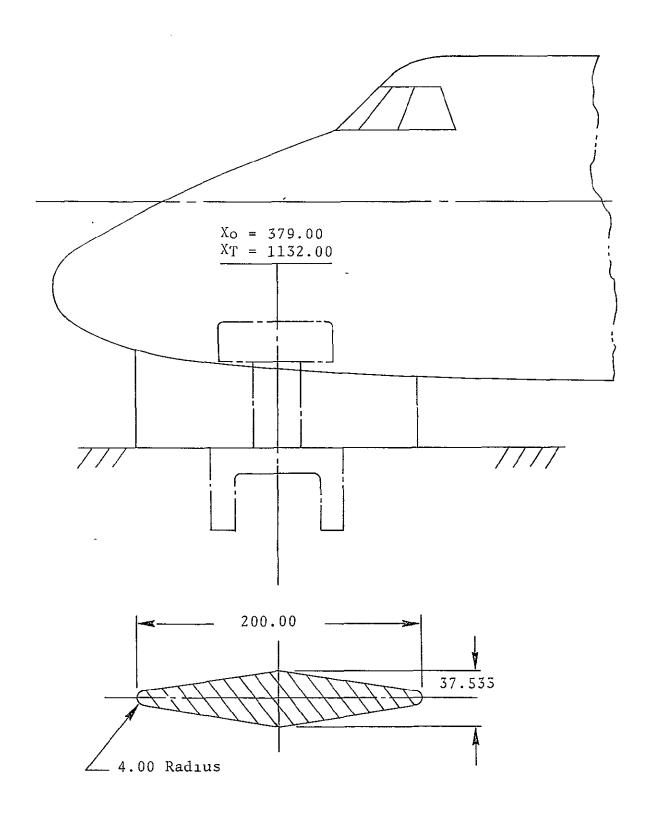




a. General Arrangement, - 140A/B Orbiter Figure 2. - Model sketches.



b. Mated Vehicle ConfigurationFigure 2. - Continued.

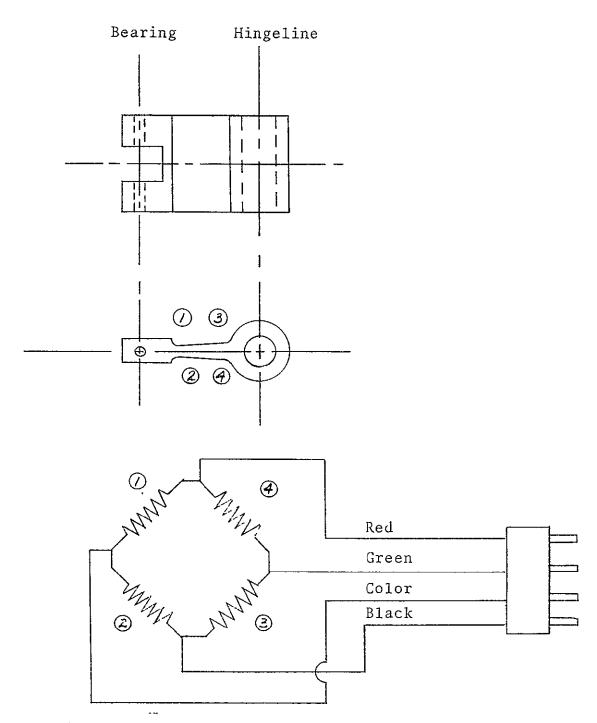


c. Forward Orbiter/ET Attach Hardware

Figure 2. - Continued.

d. Aft Orbiter/ET Attach Hardware

Figure 2. - Continued.

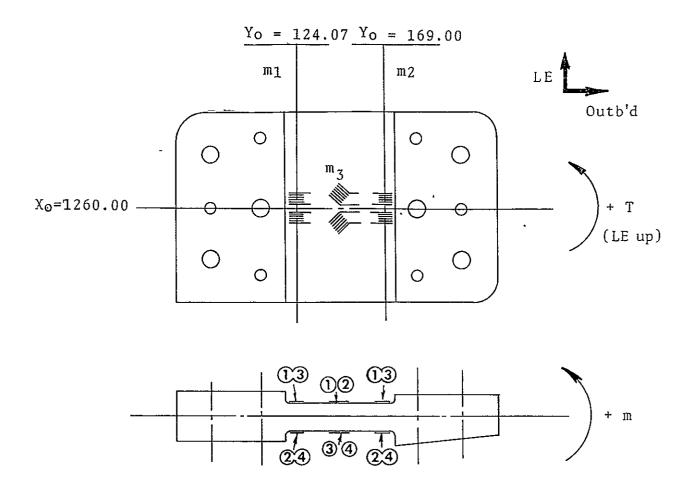


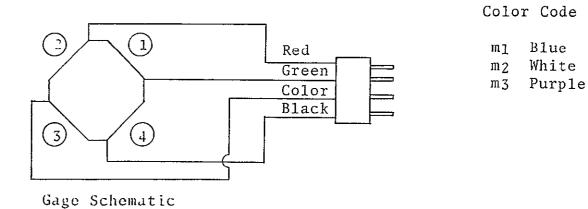
Color Code

Inboard Elevon Grey
Outboard Elevon Yellow
Body Flap Orange

e. Elevon and Bodyflap Hinge Moment Gage

Figure 2. - Continued.



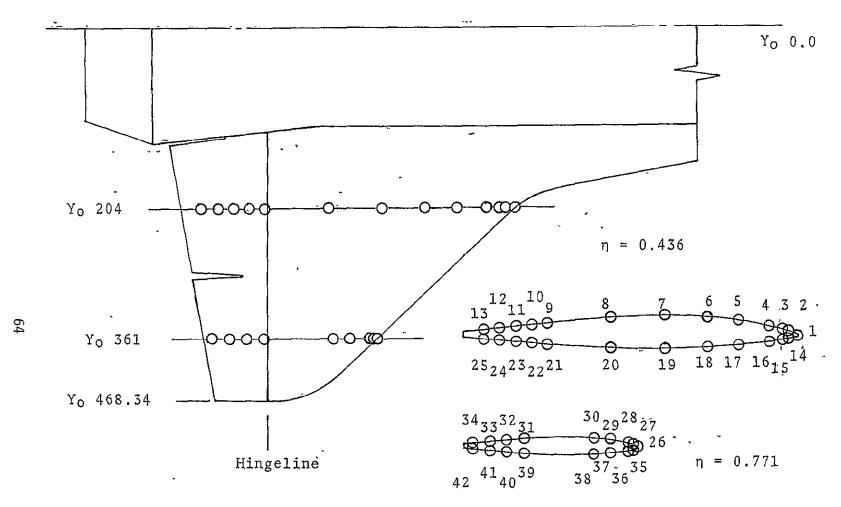


f. Wing Bending And Torsion Gagé

Figure 2. - Continued.

g. Installation Sketch

Figure 2. - Continued.

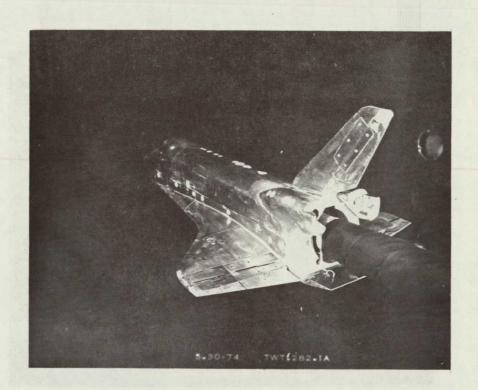


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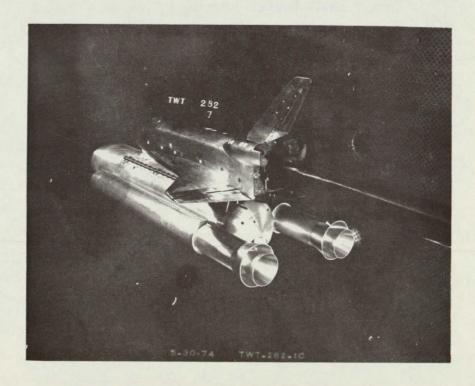
- (1) Full Scale Dimensions
- (2) Pressure Orifices are for Right-Hand Wing
- (3) See Table IV for X/C Locations

h. Orbiter Wing Pressure Tap Locations

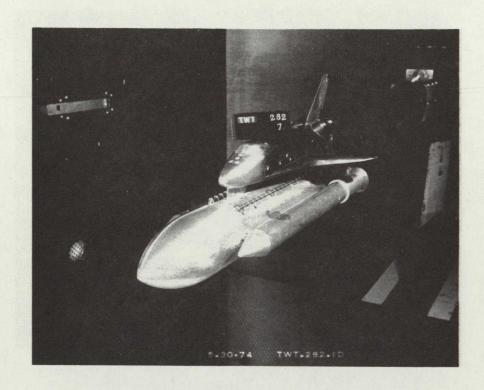
Figure 2. - Concluded.



a. Aft View, TWT Installation Orbiter $_{\rm B26}$ Cg M7 F7 W116 E7 V8 R15

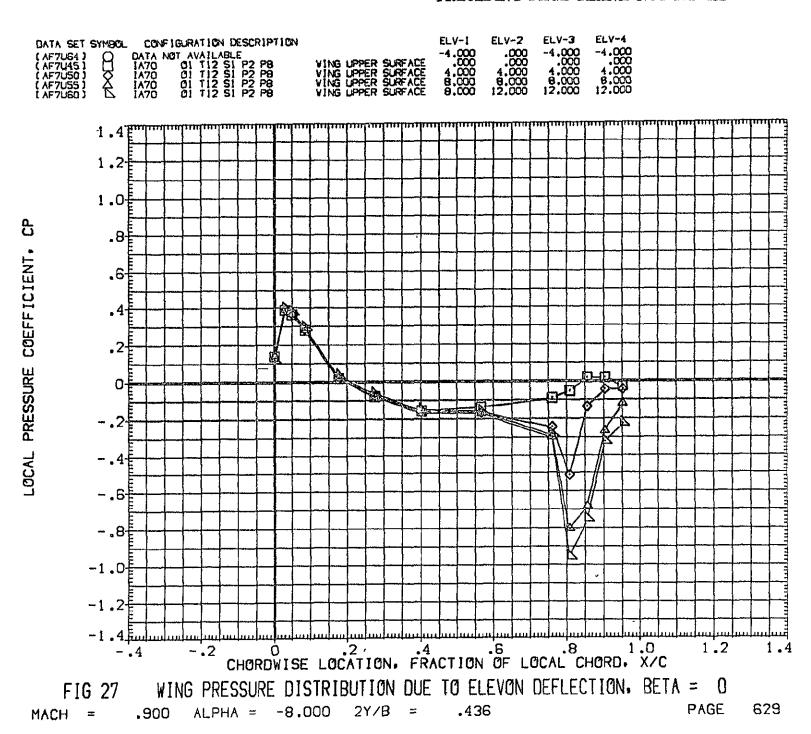


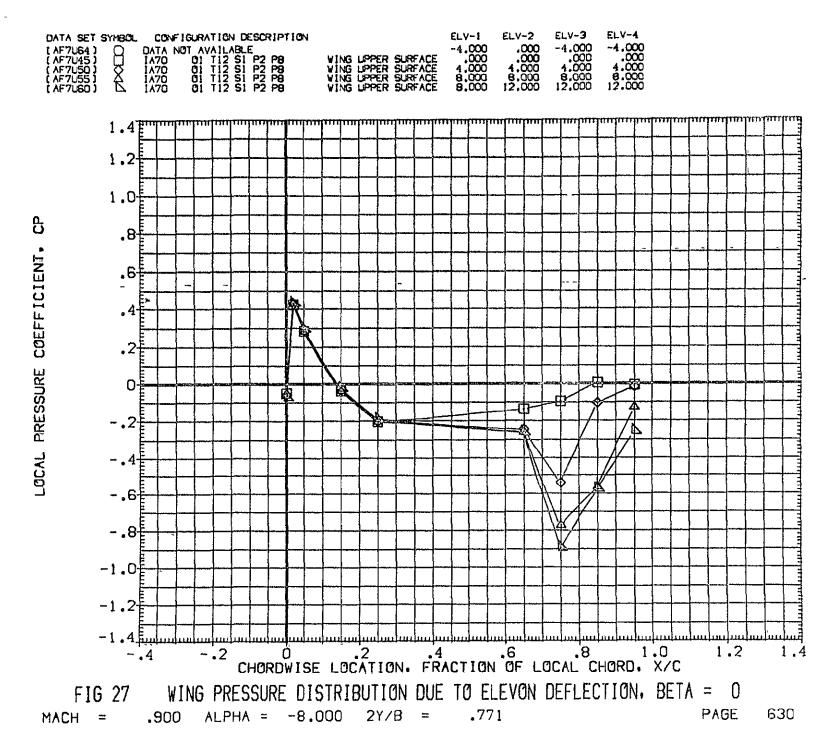
 Aft View, TWT Installation Orbiter + Eternal Tank + Solid Rocket Motors
 Figure 3. - Model installation.

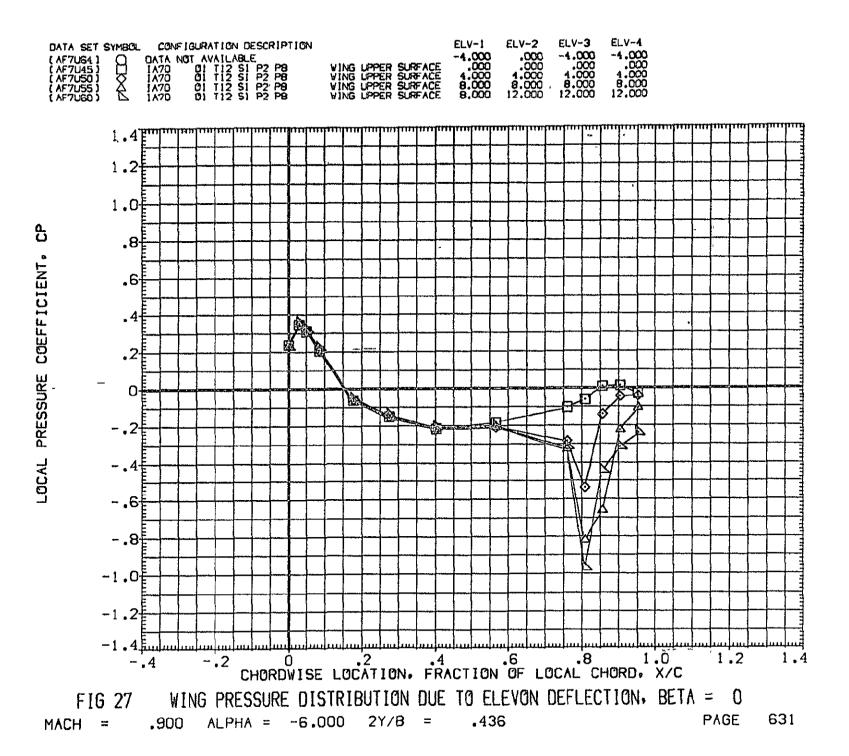


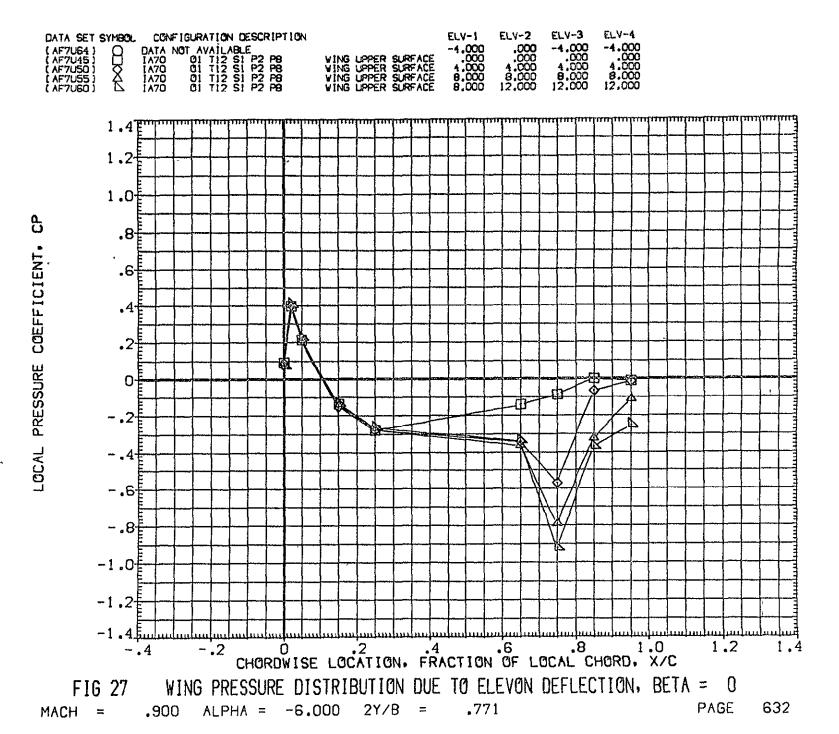
c. Front View, TWT Installation Orbiter + External Tank + Solid Rocket Motors

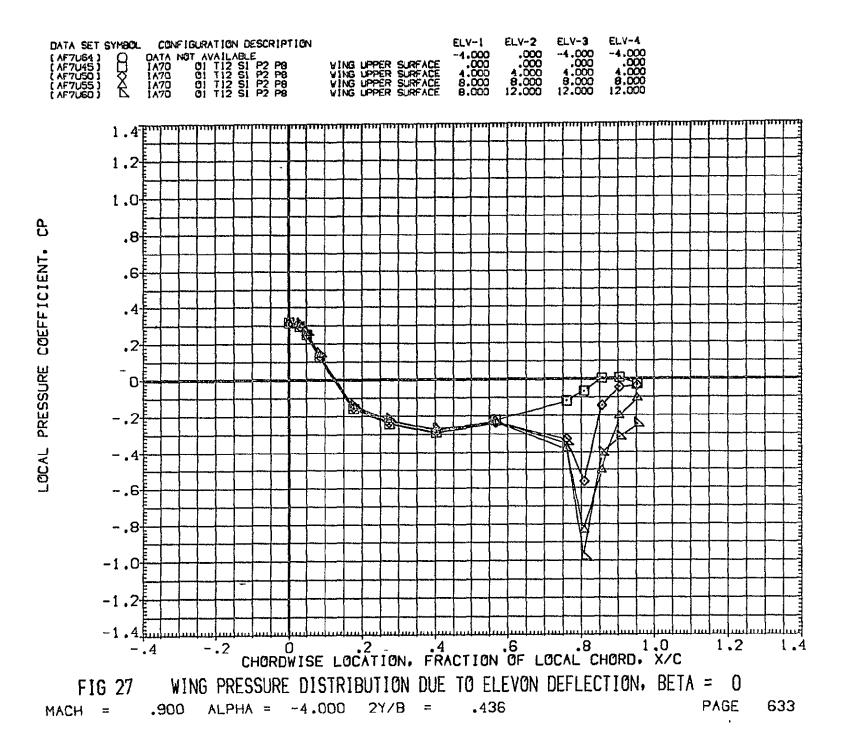
Figure 3. - Concluded.

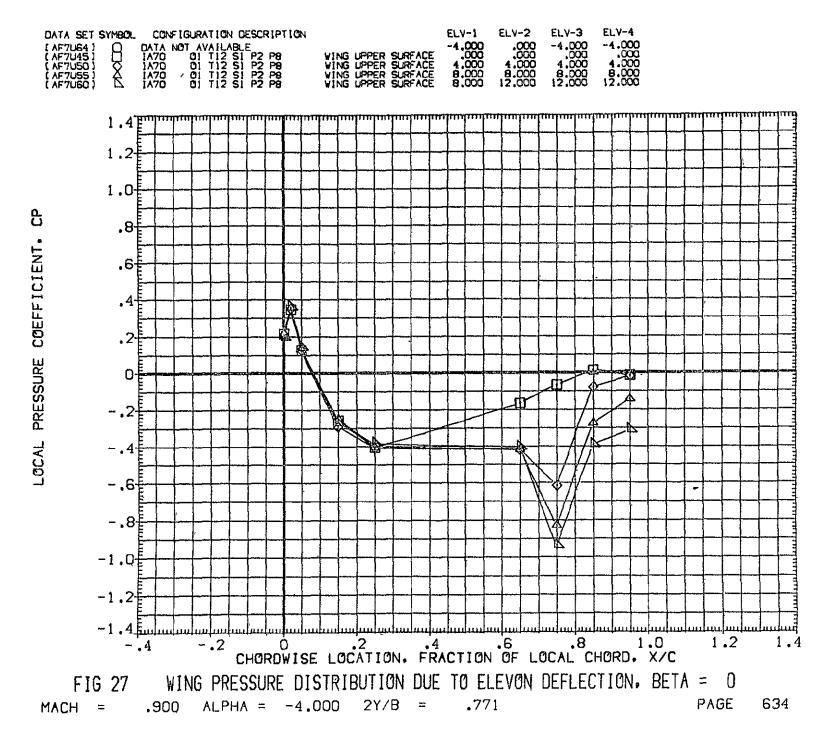


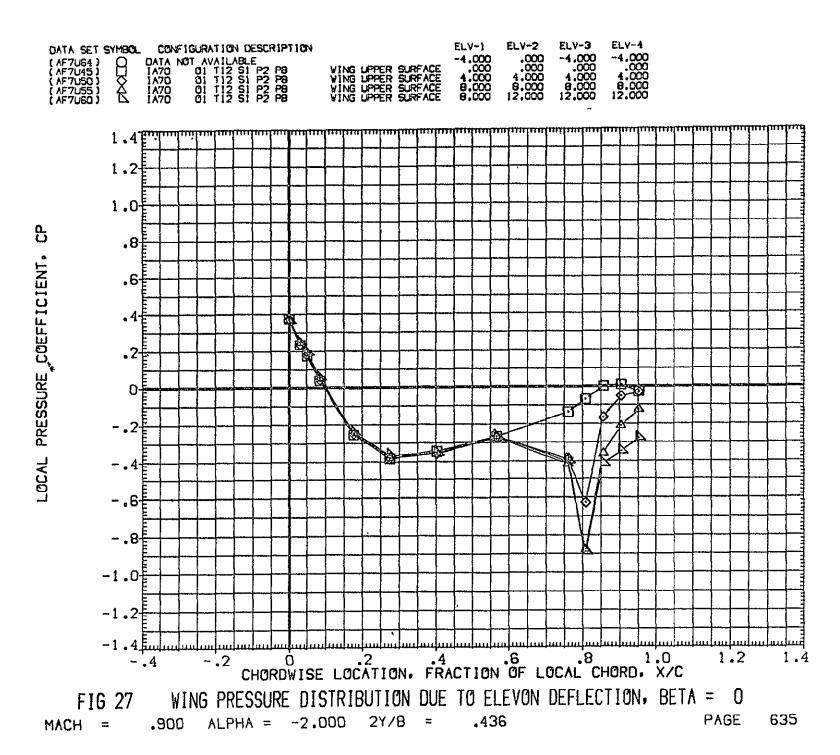


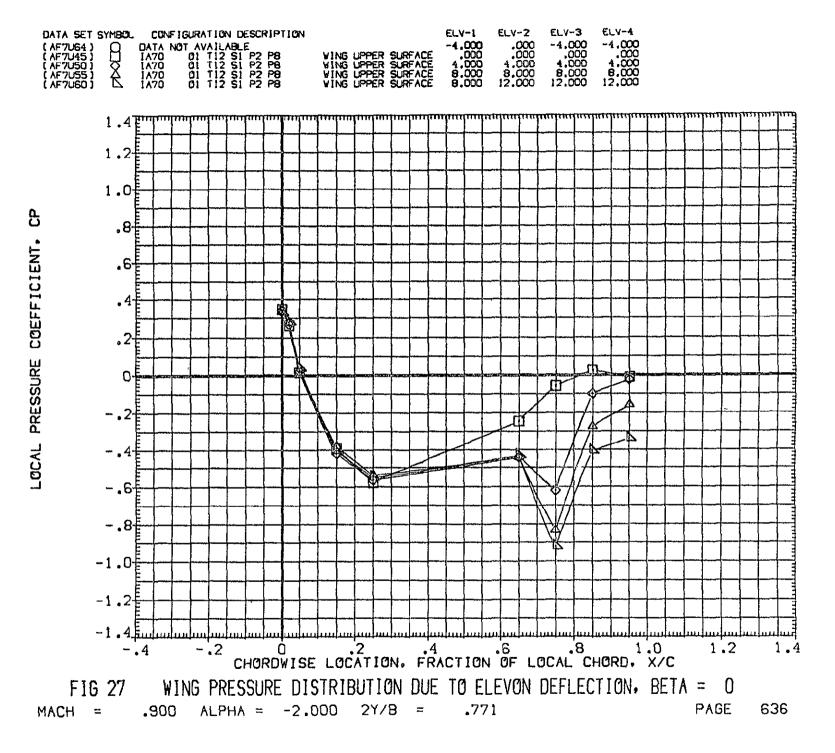


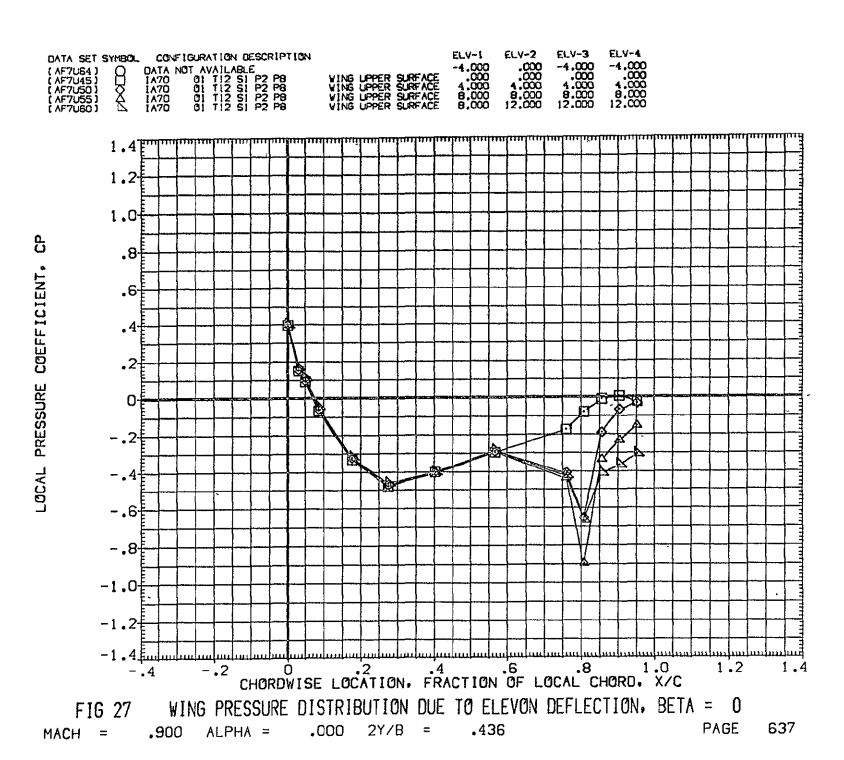


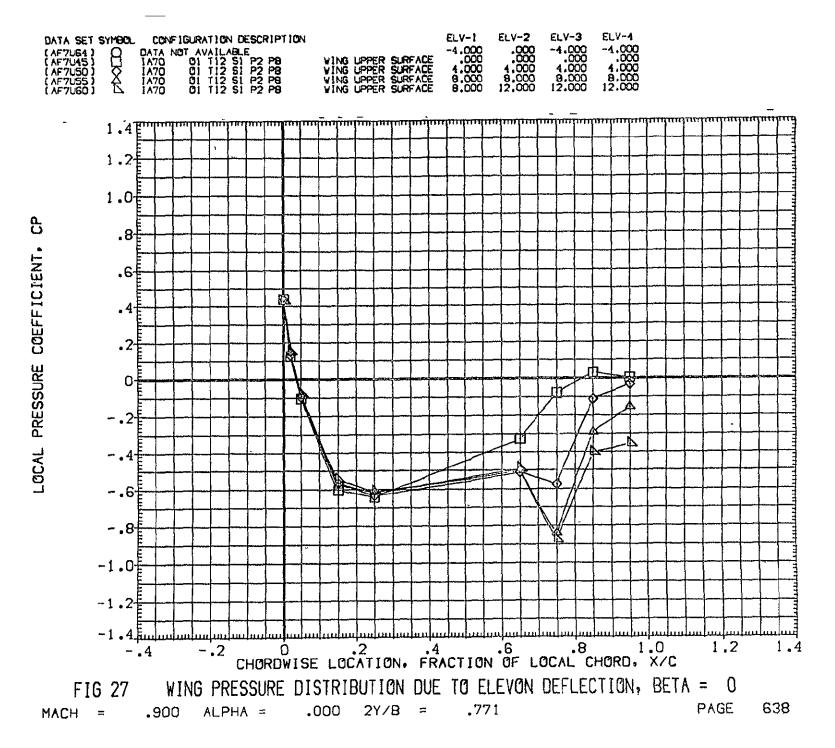


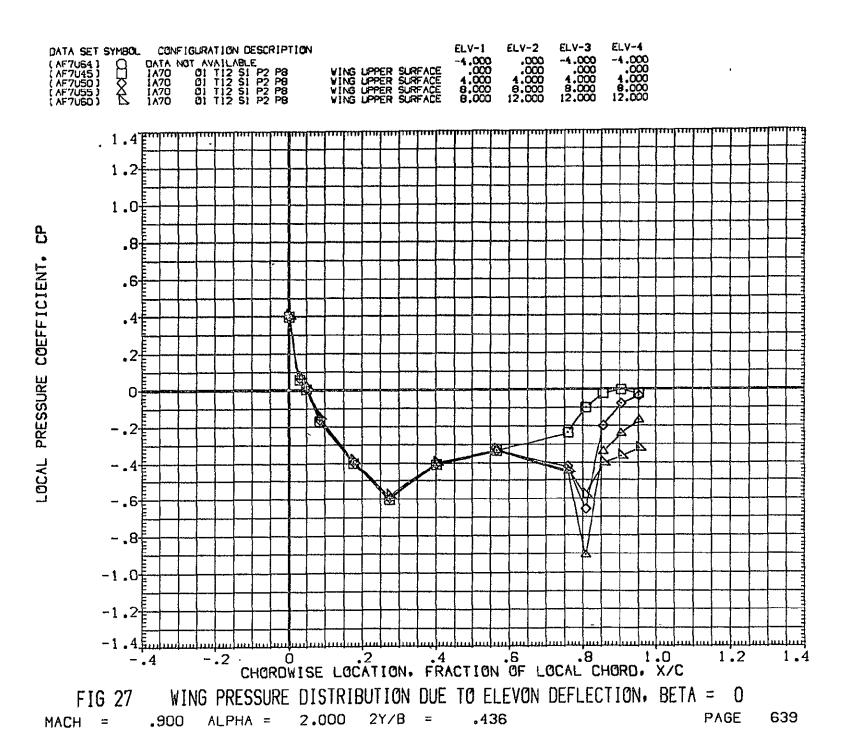


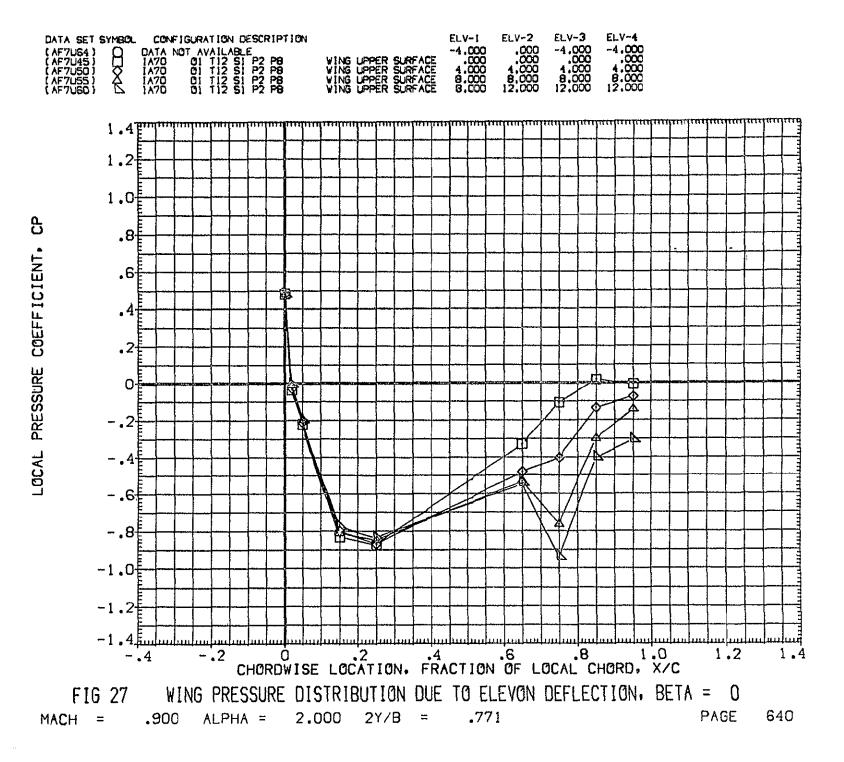


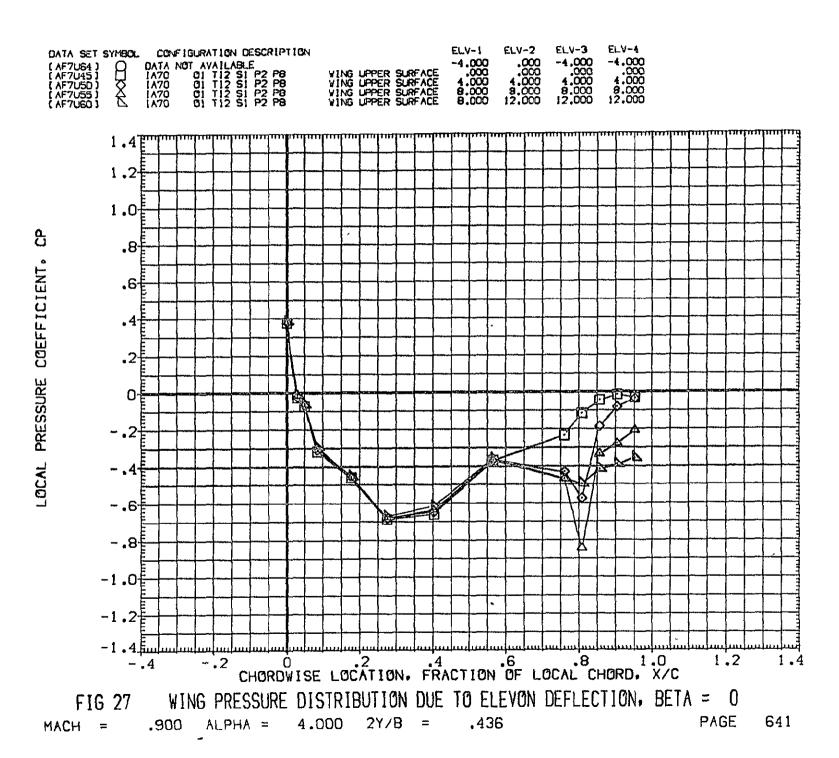


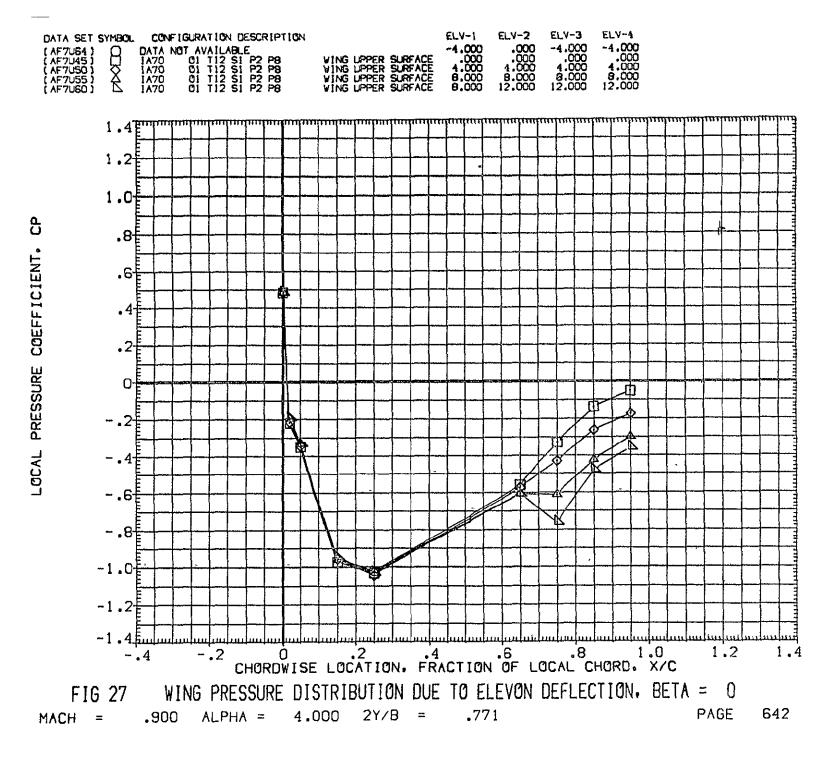


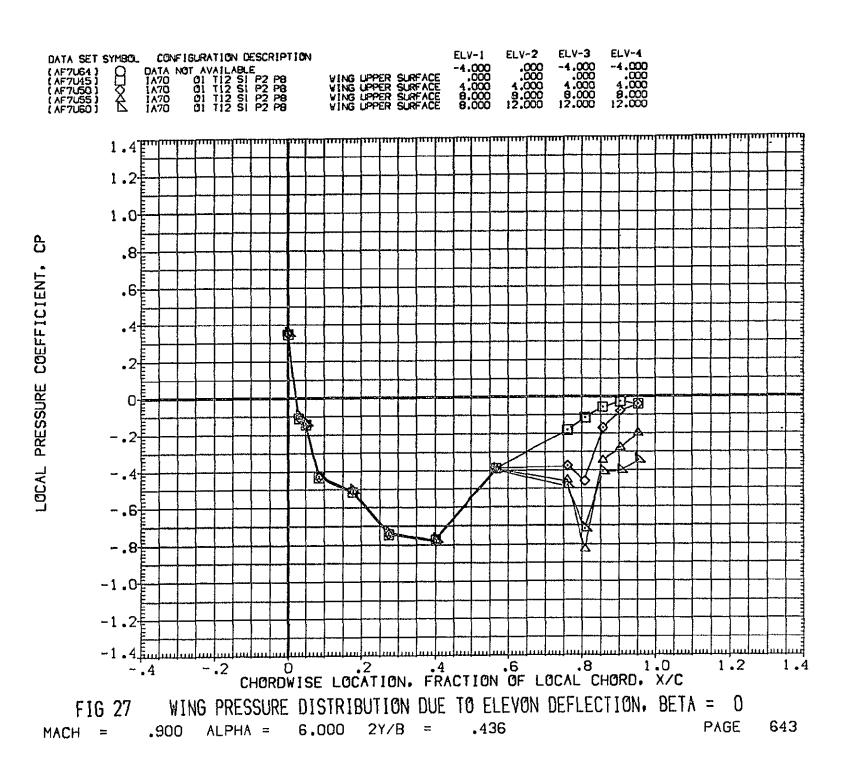


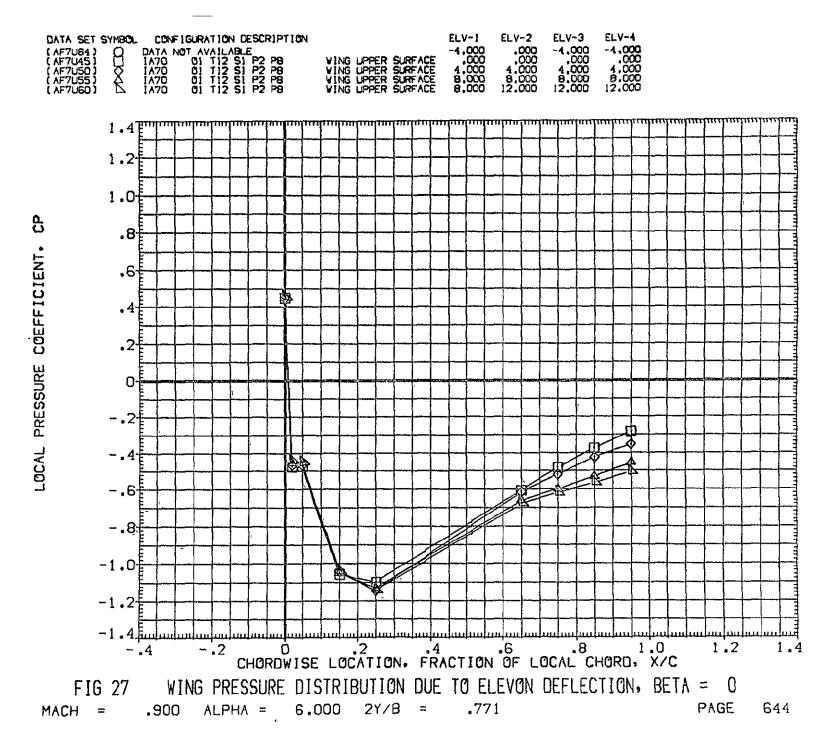


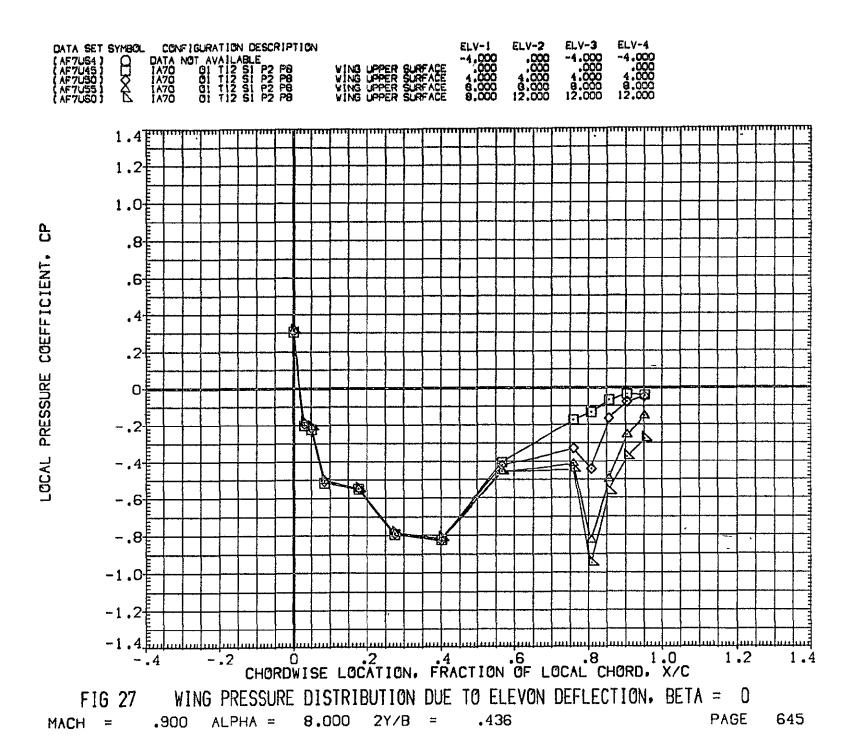


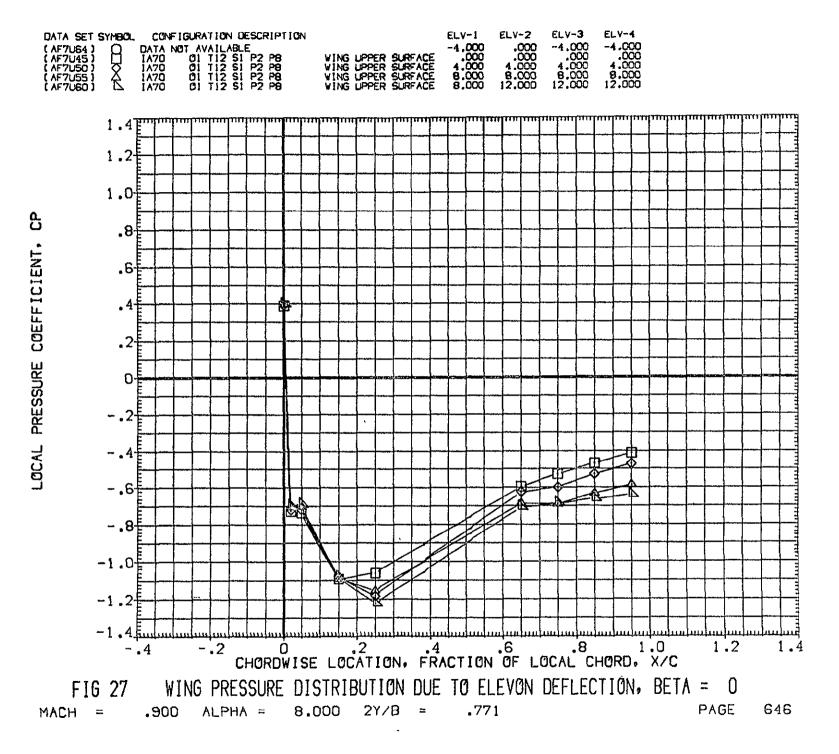


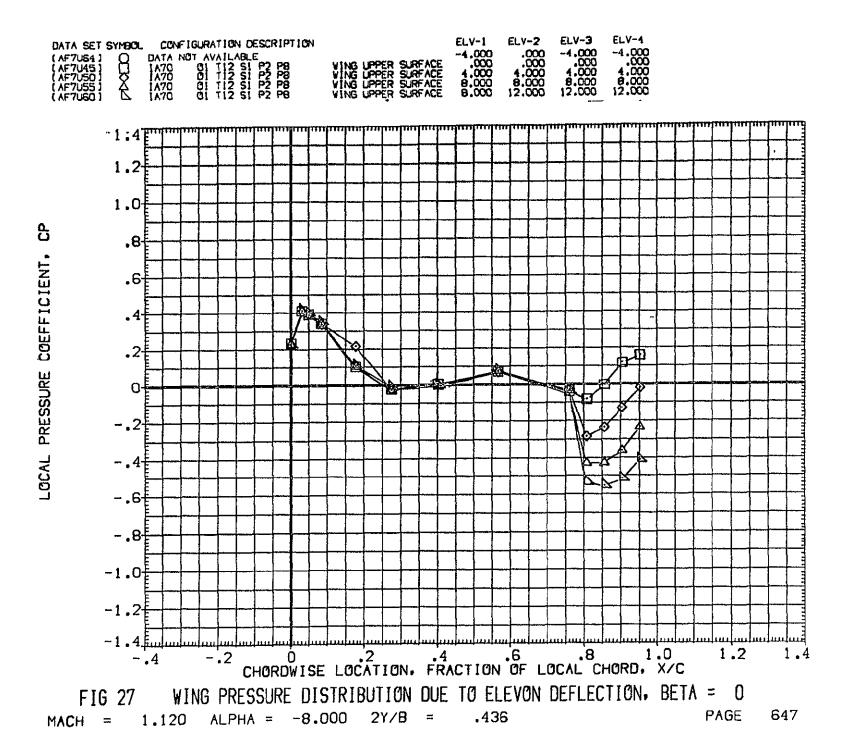


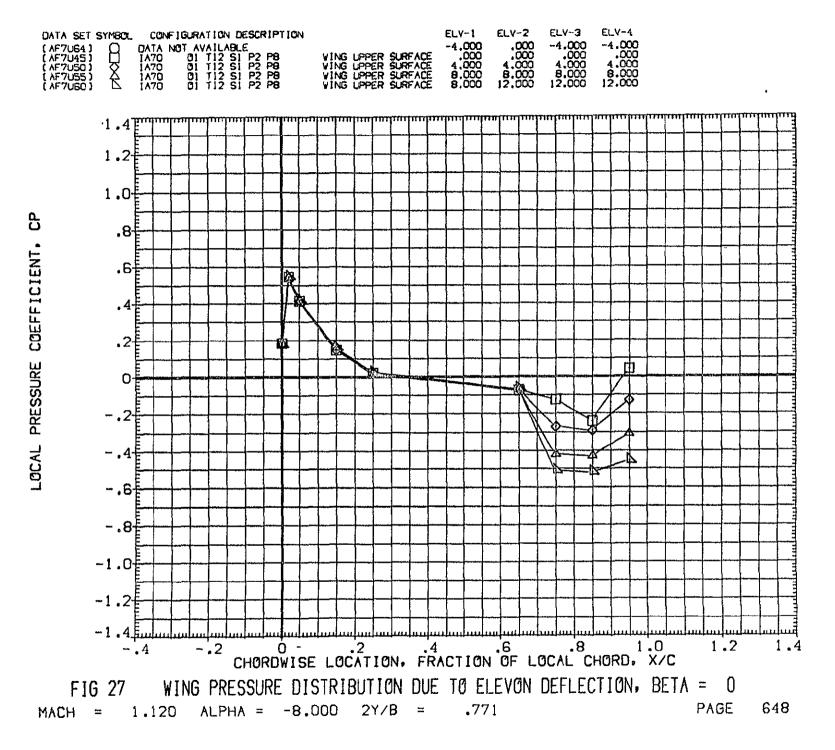


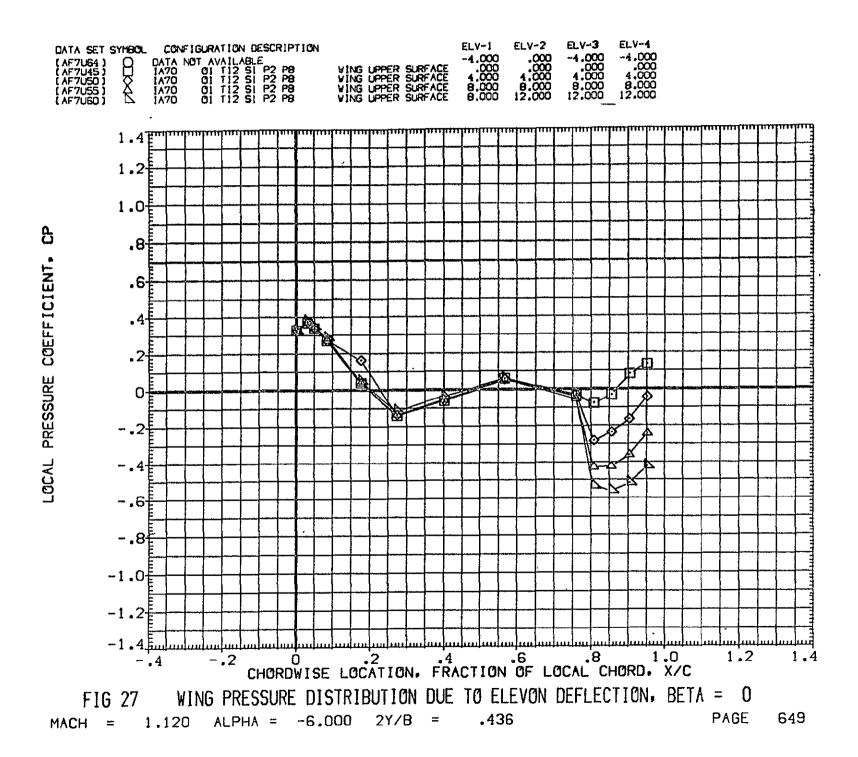


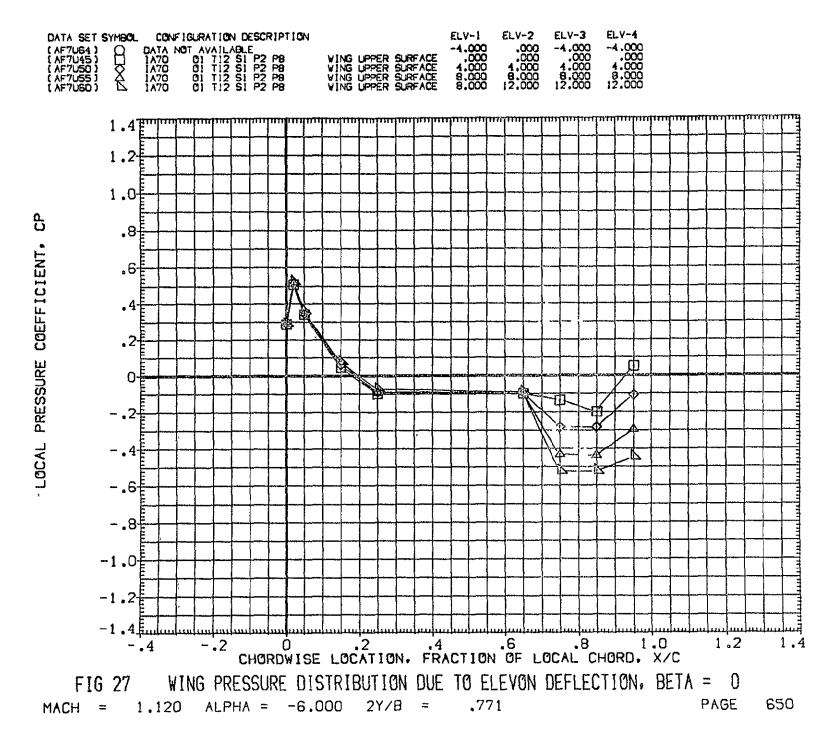


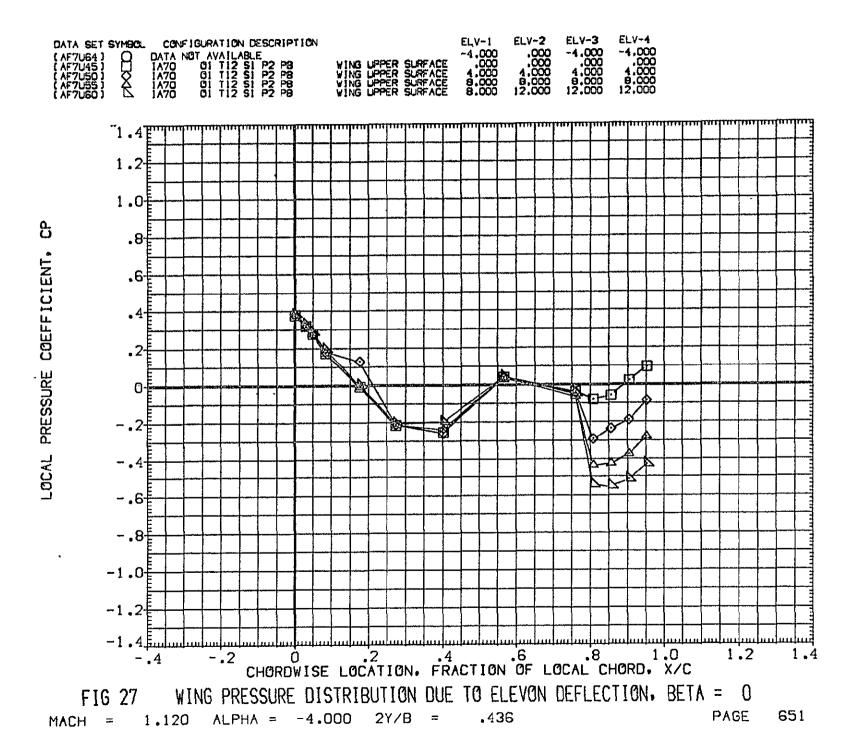


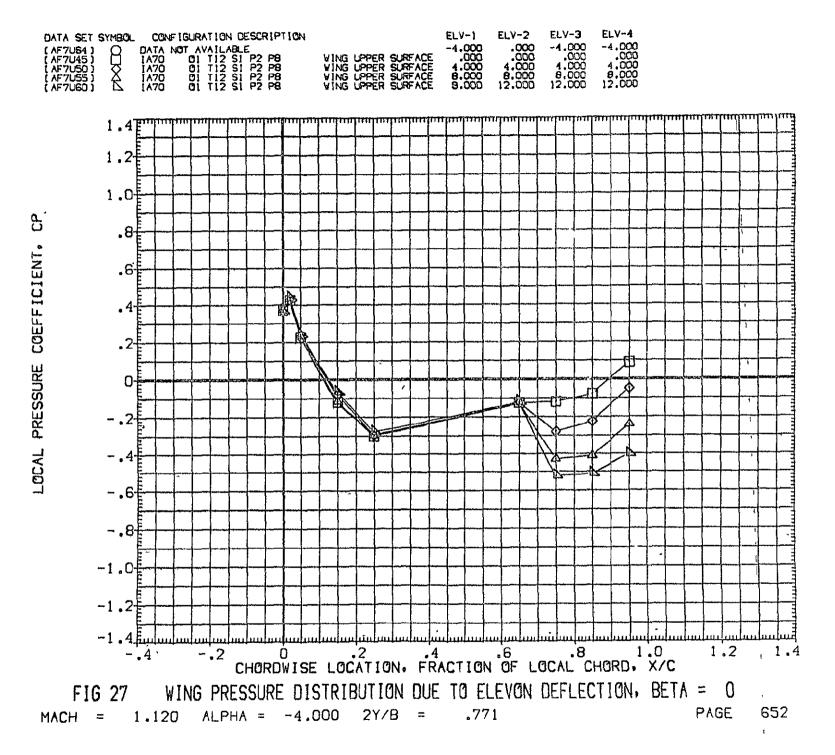


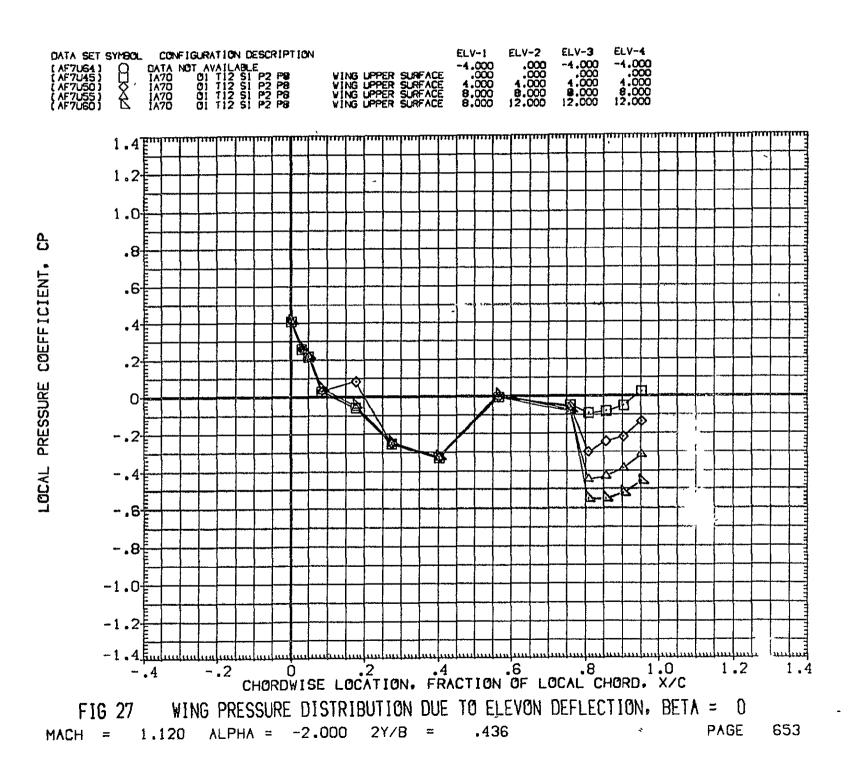


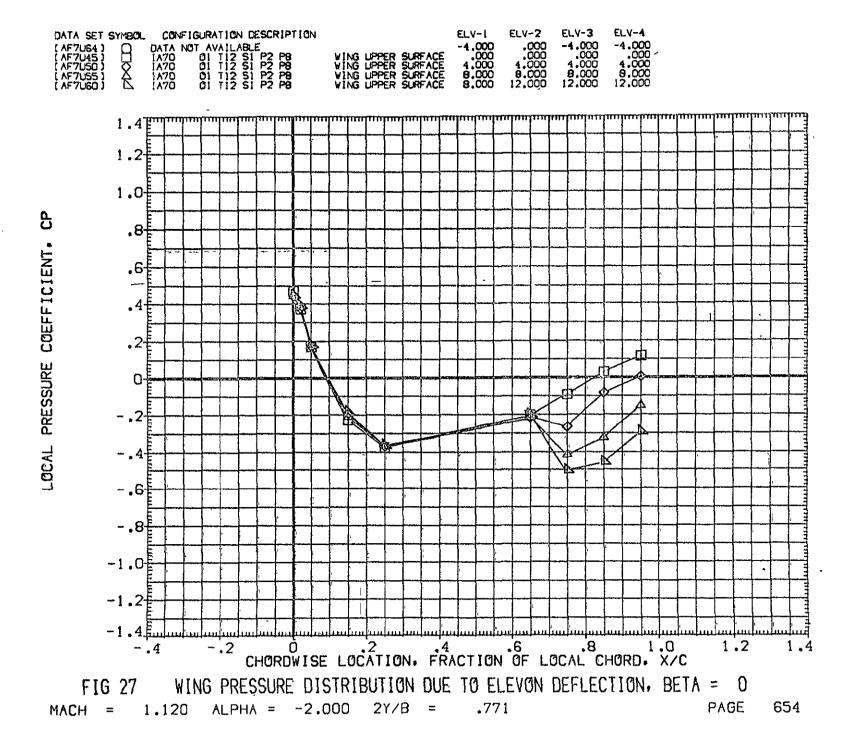


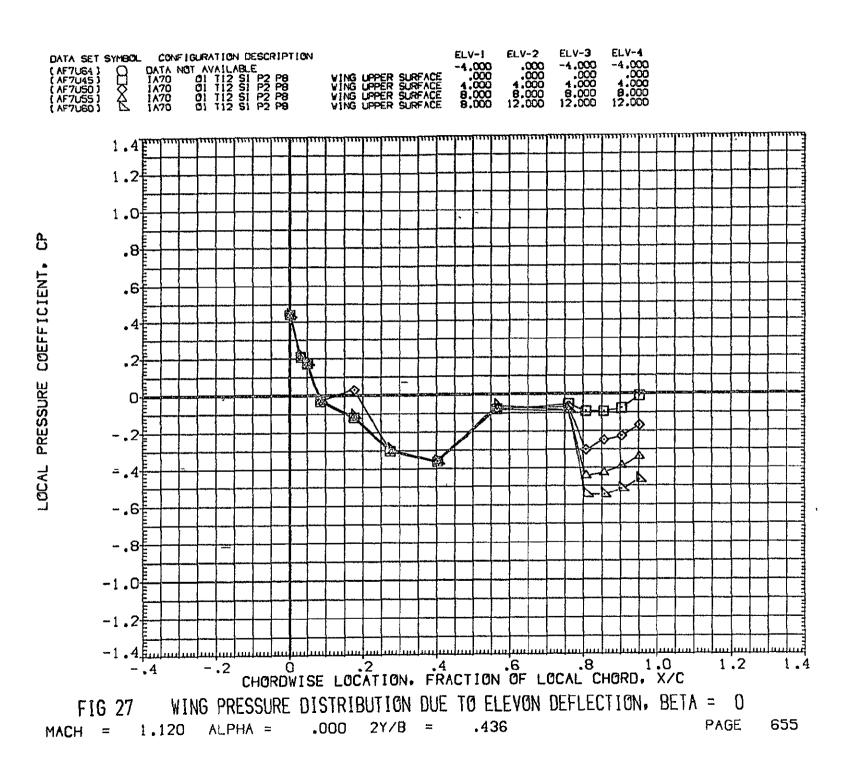


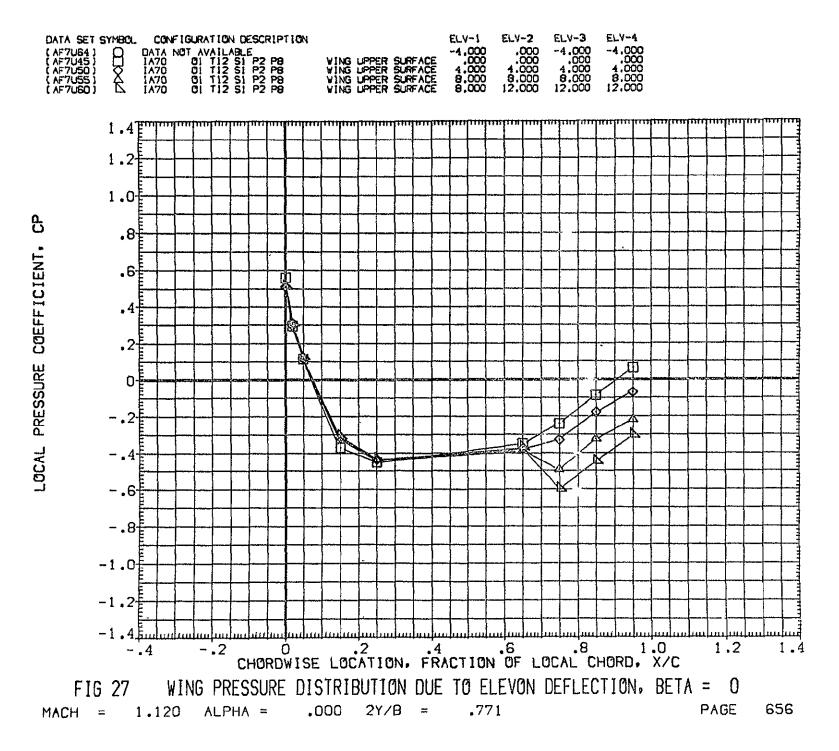


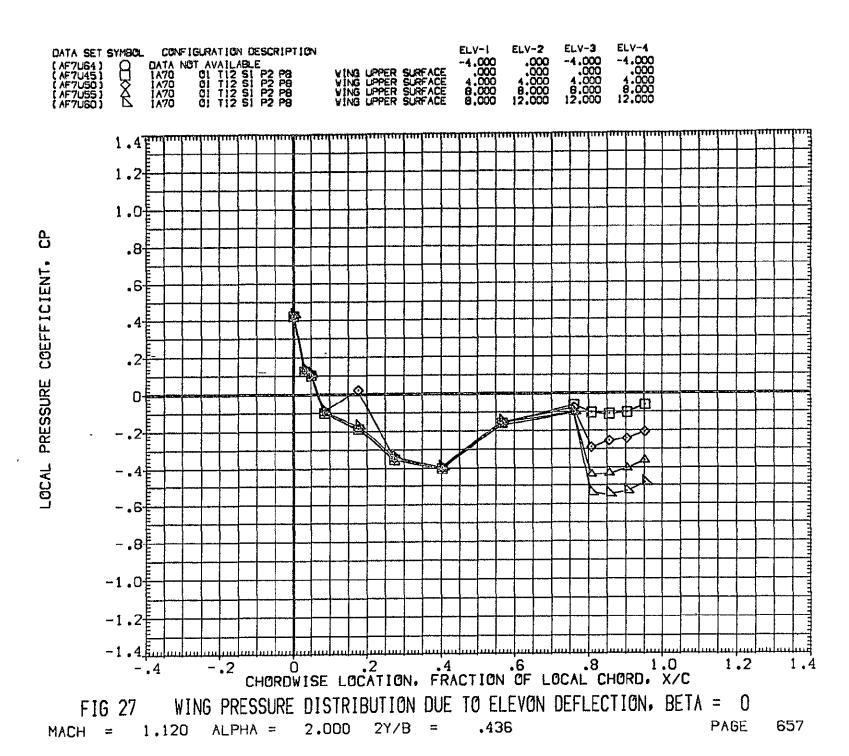


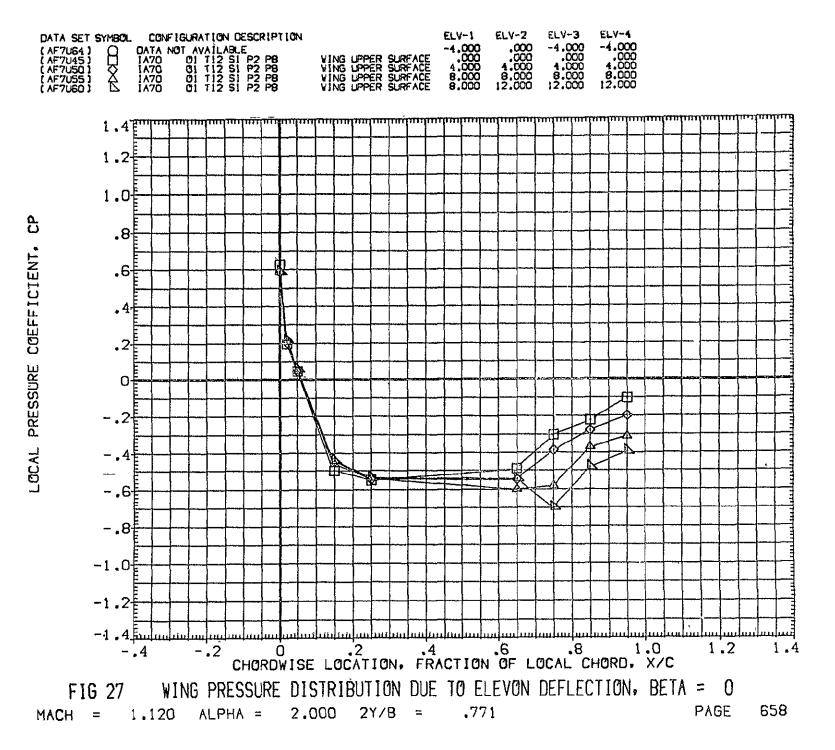


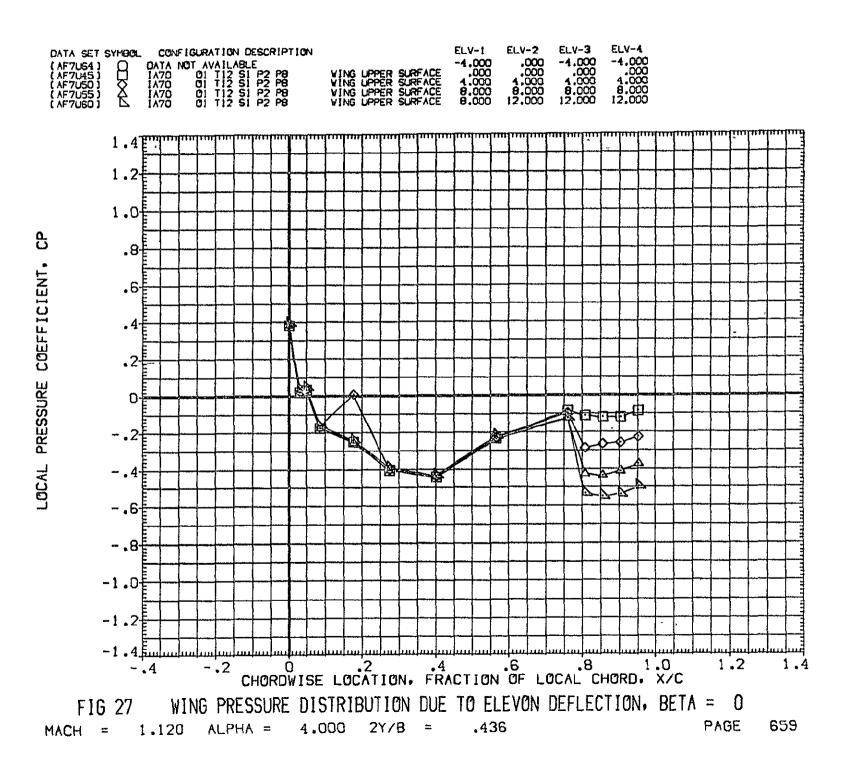


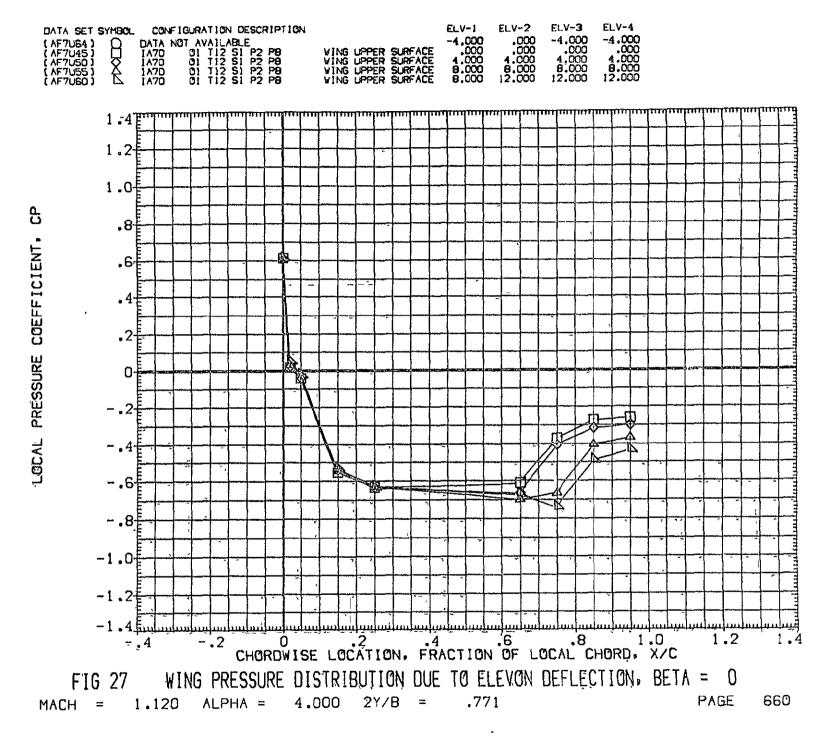


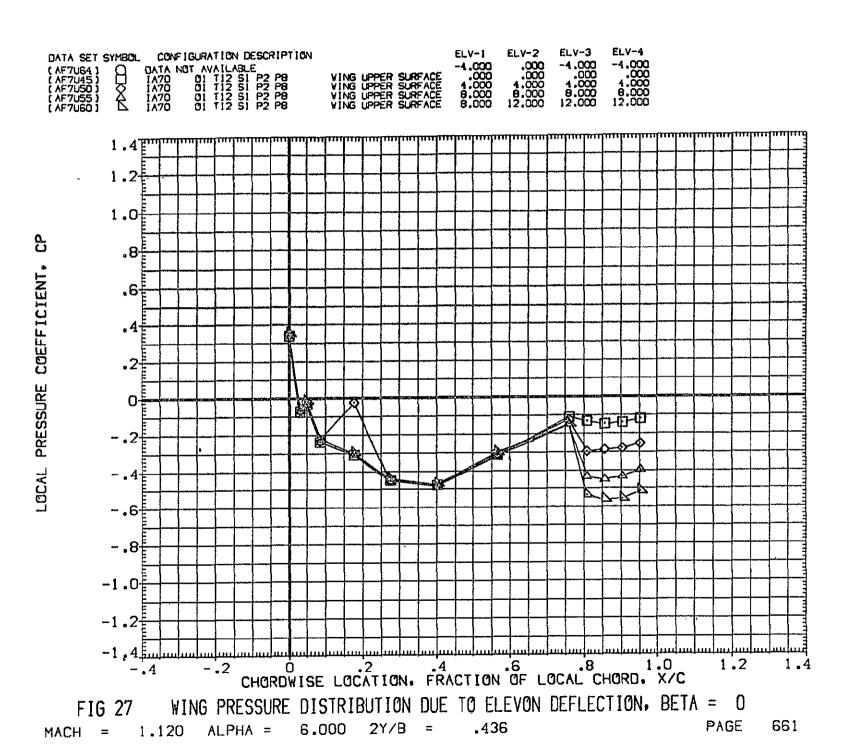


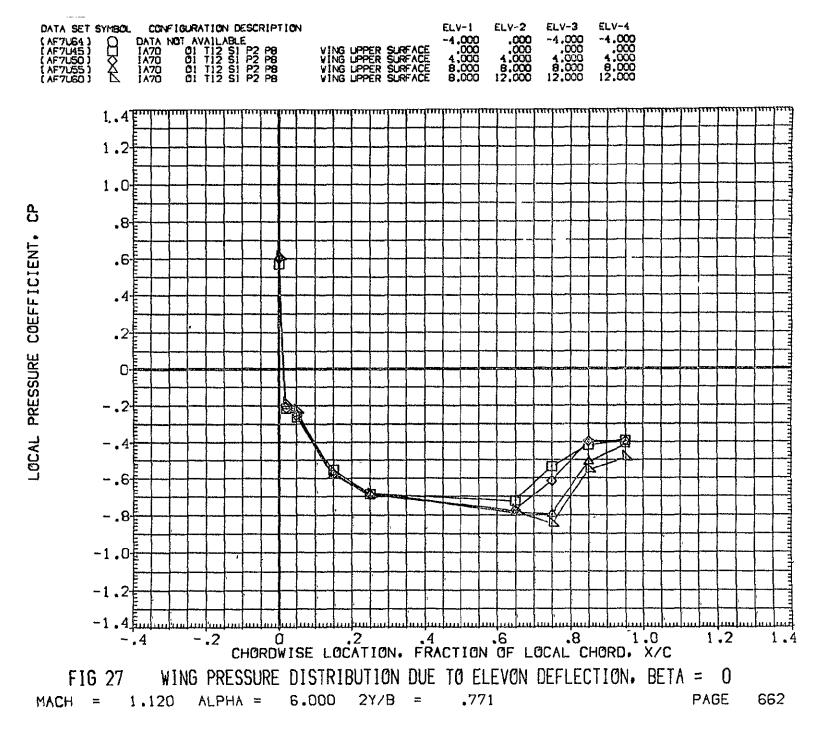


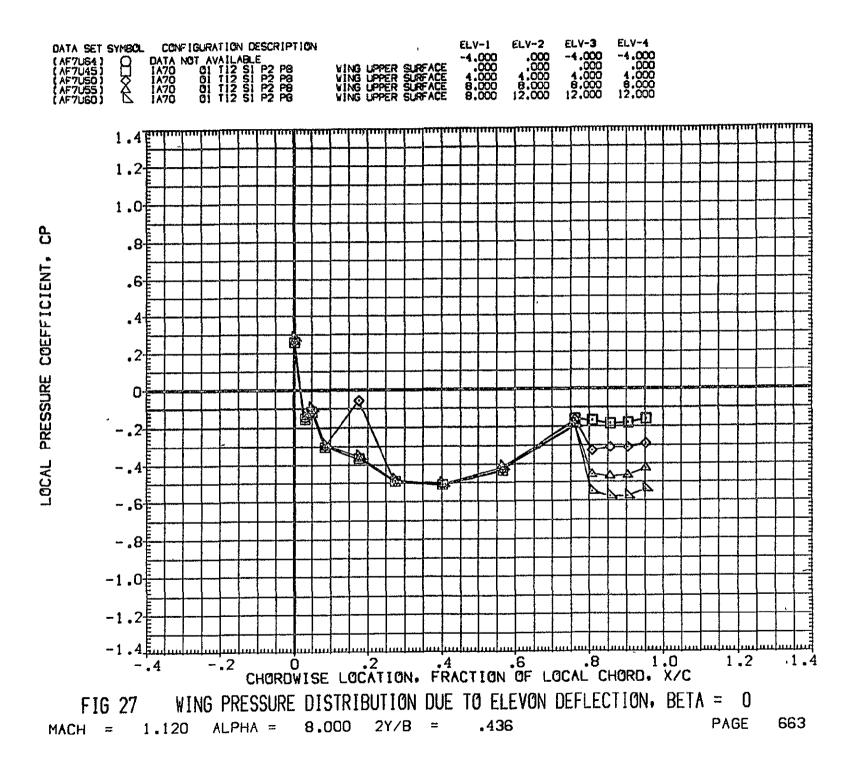


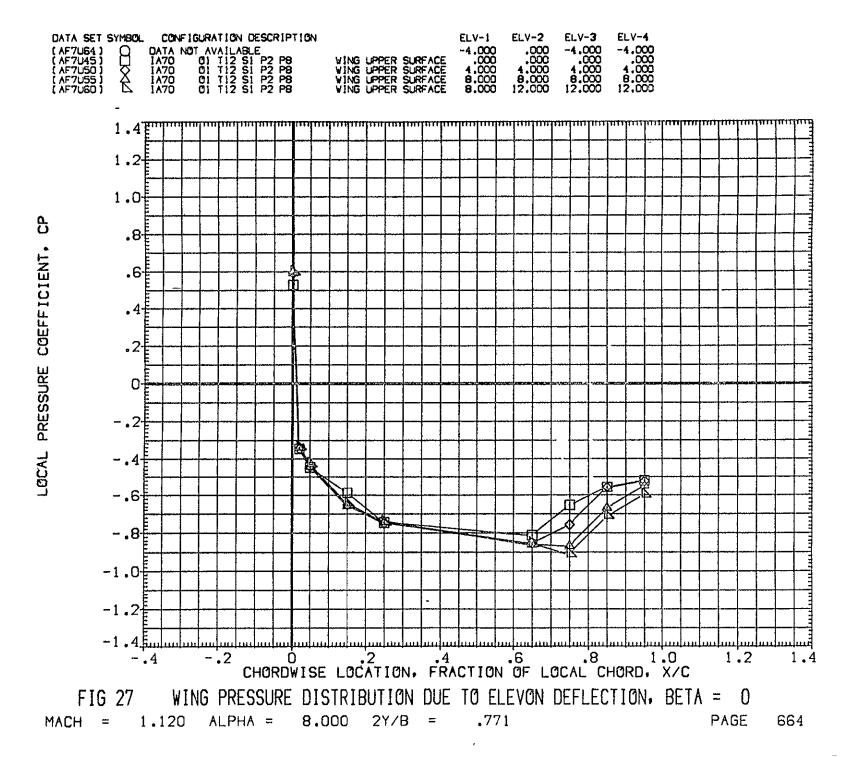


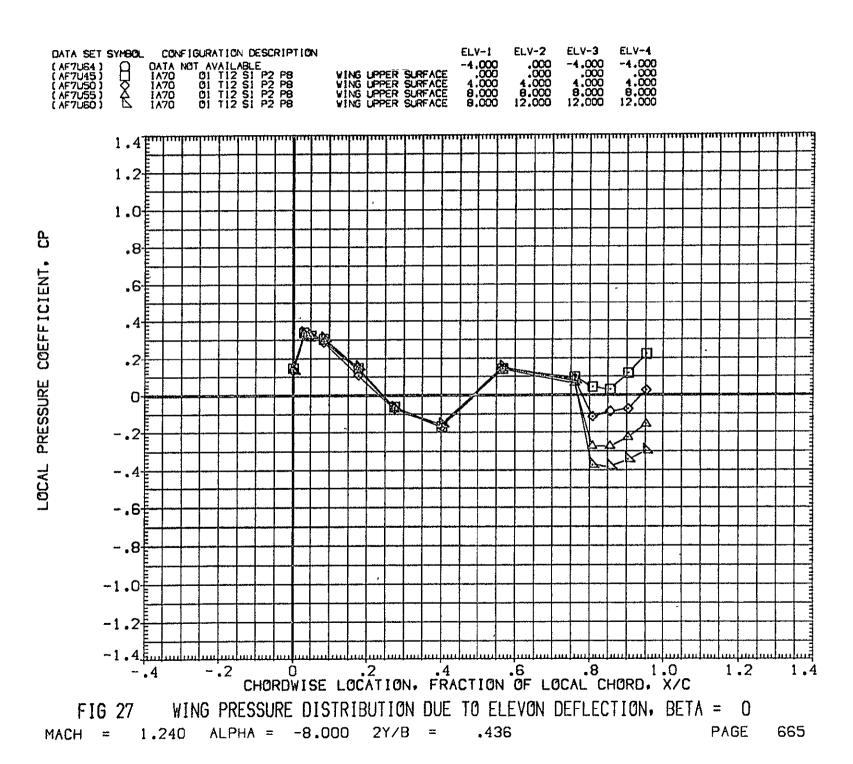


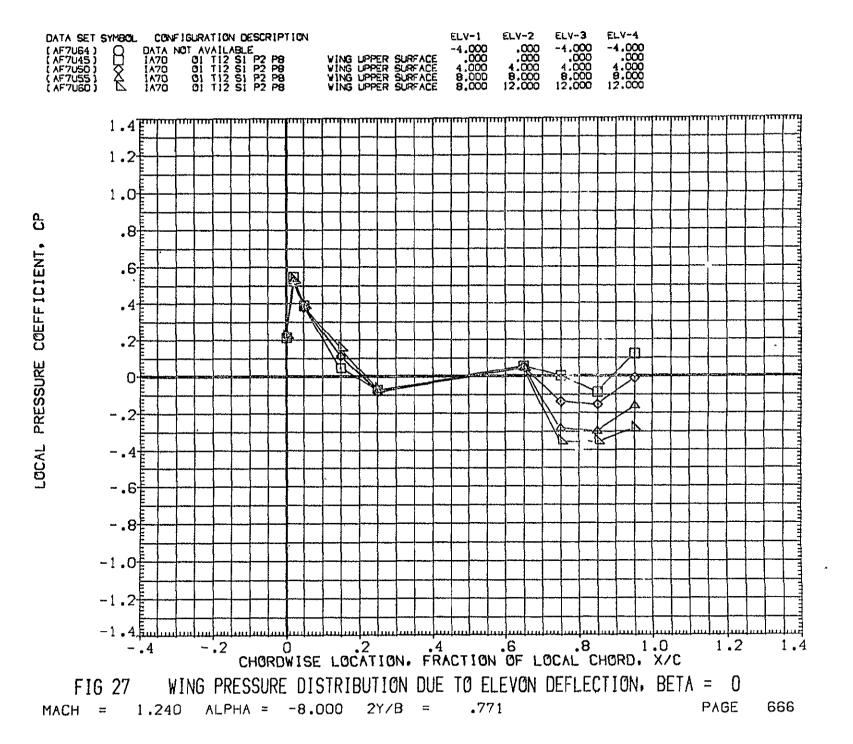


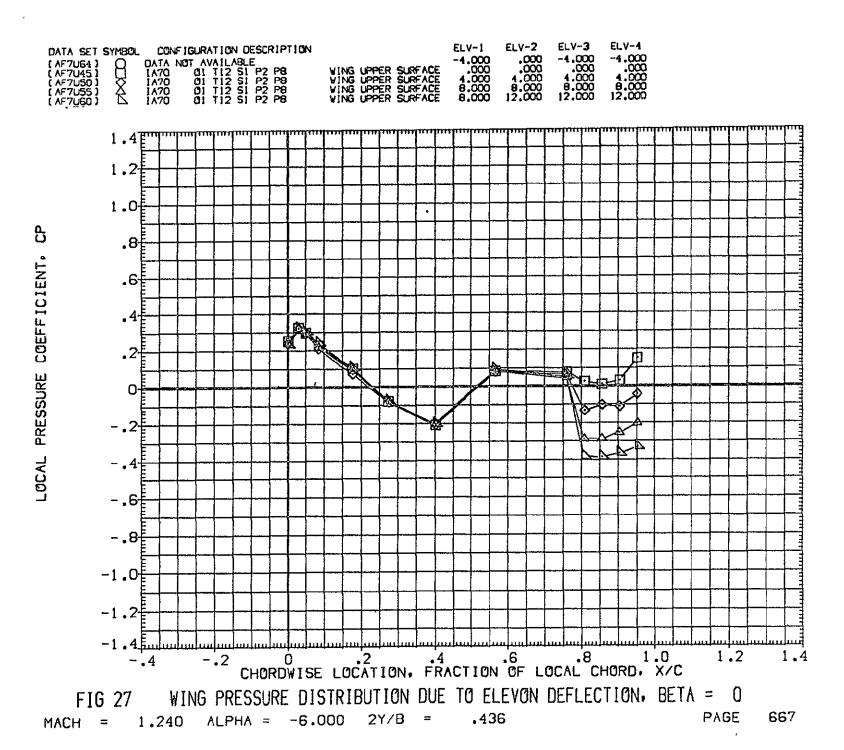


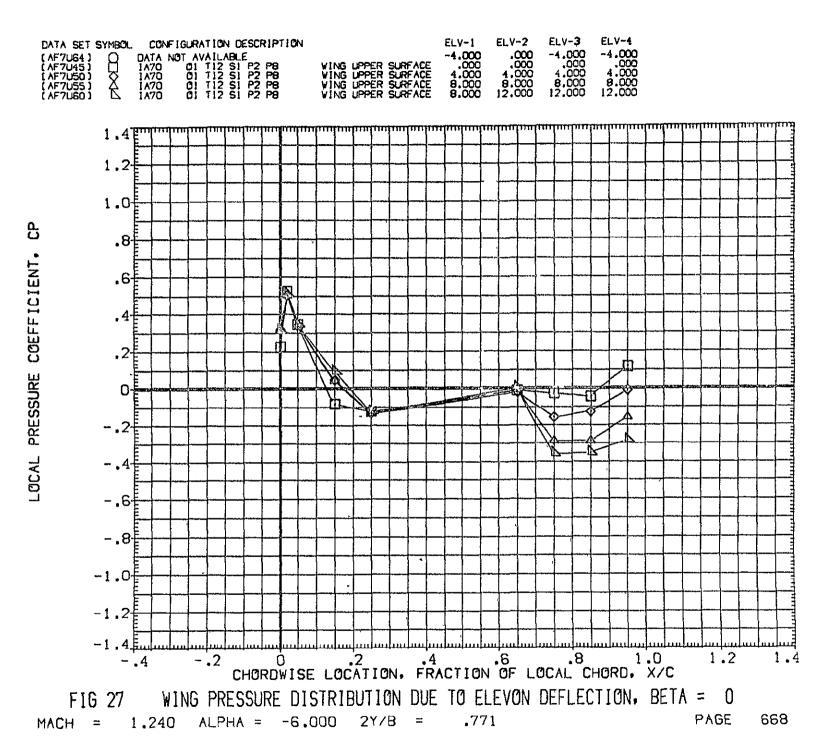


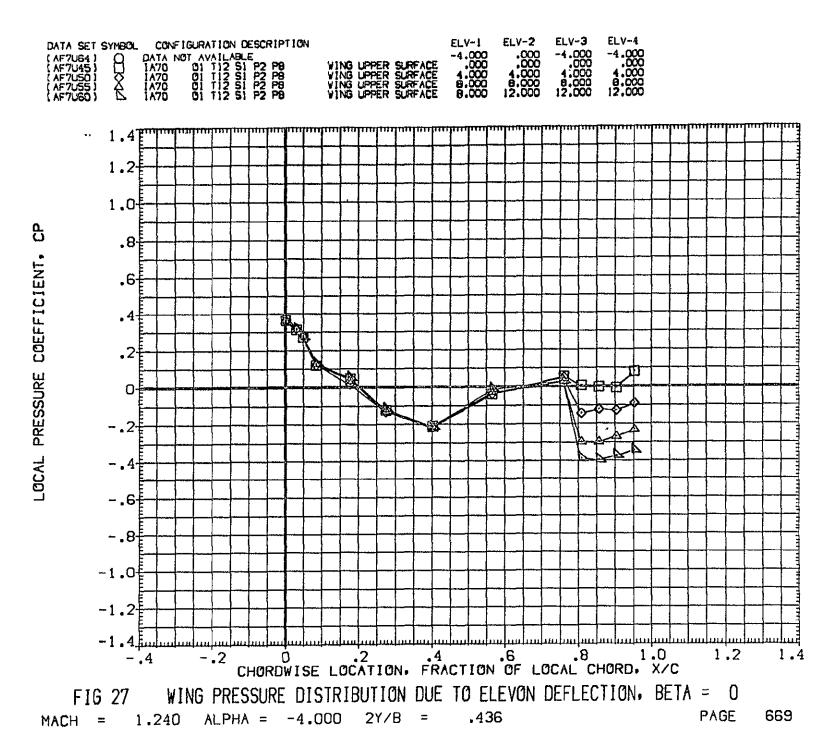


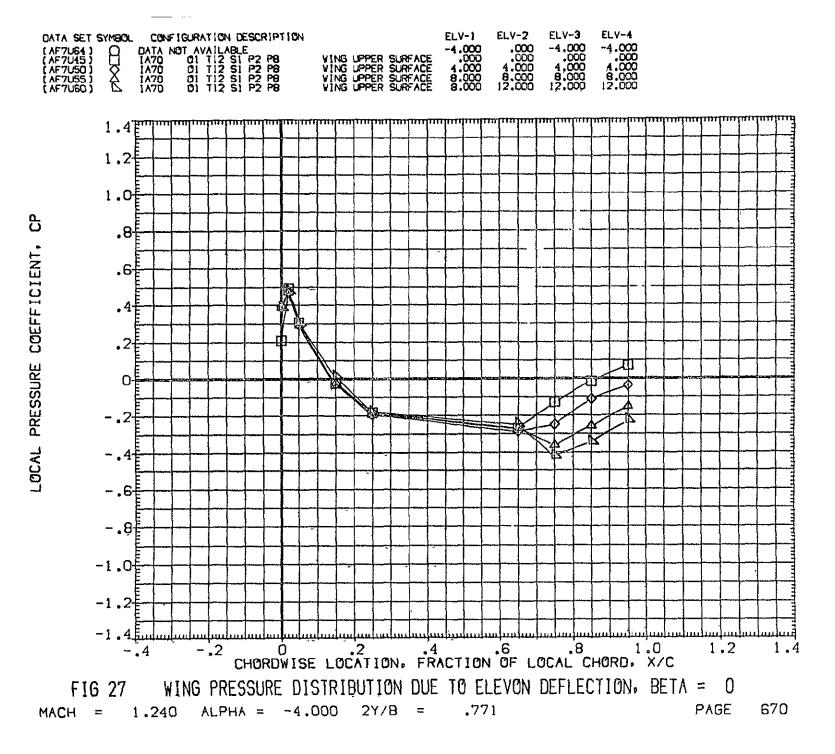


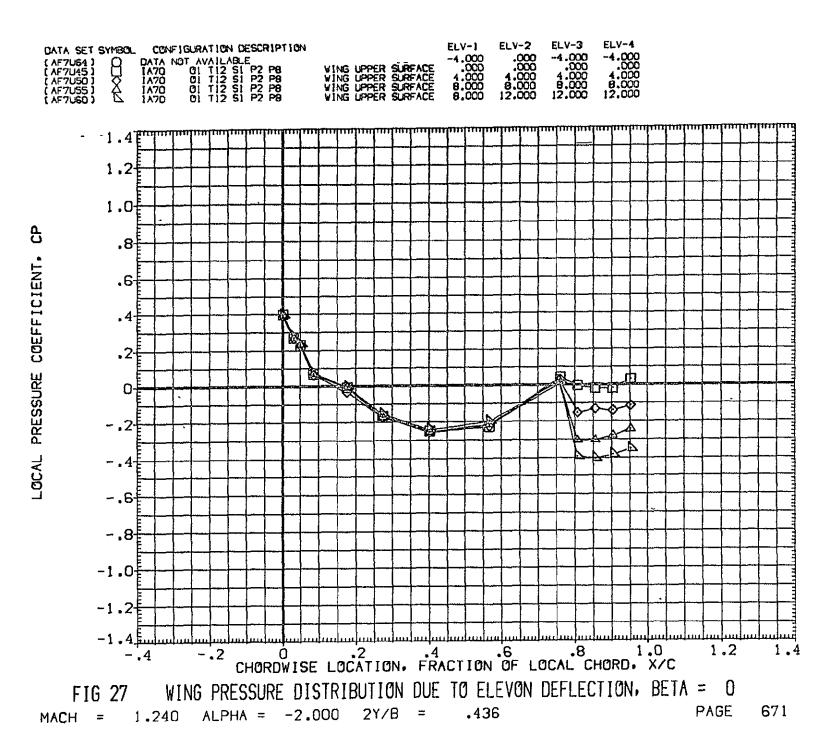


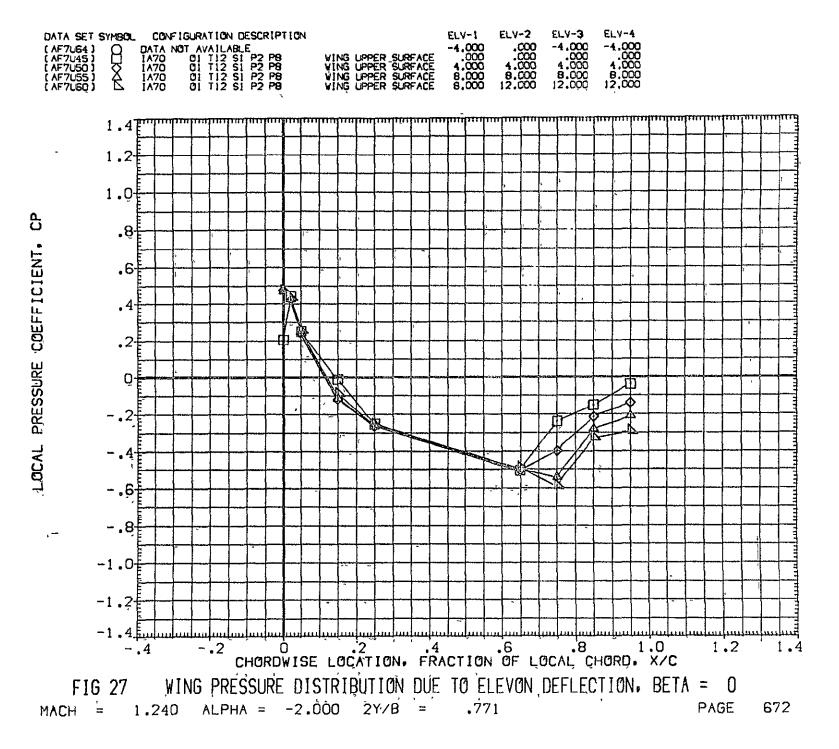


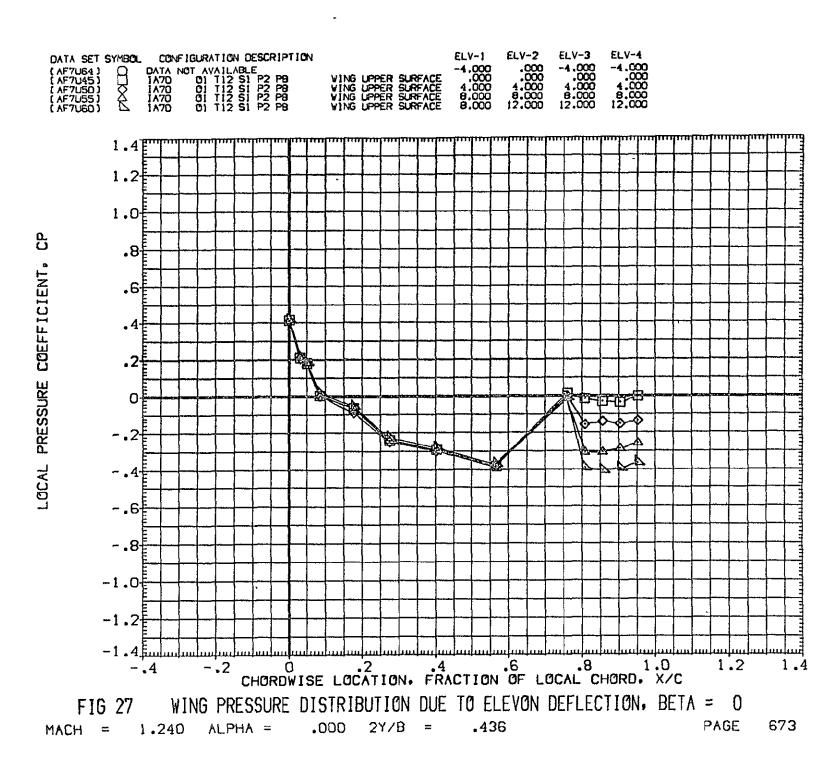


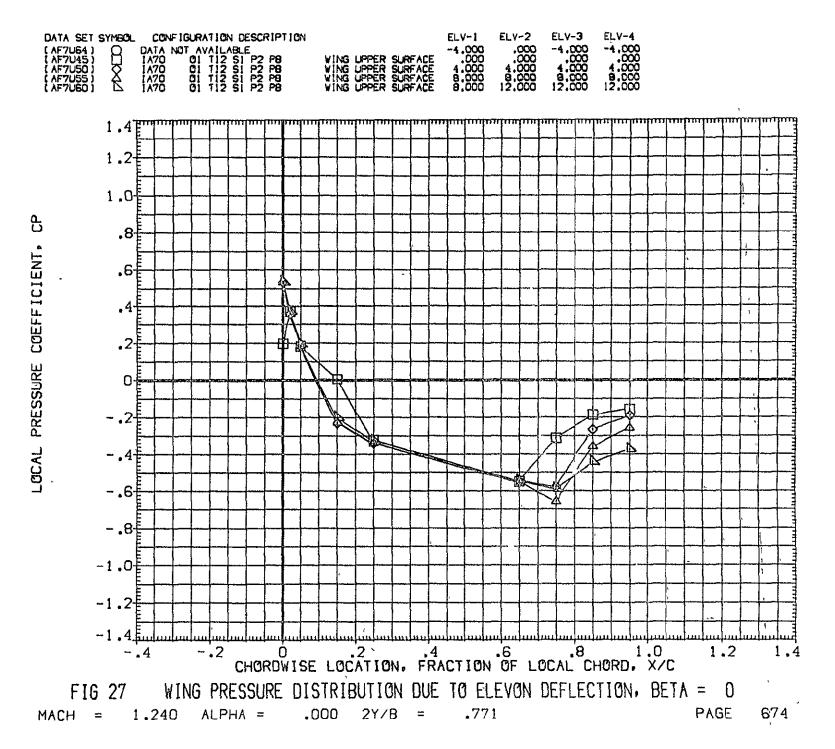


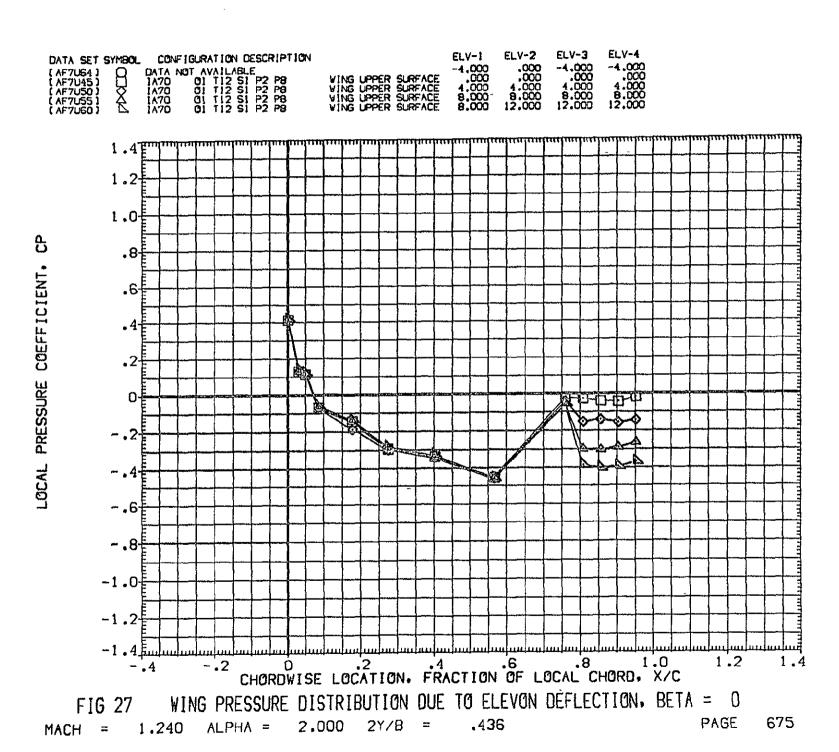


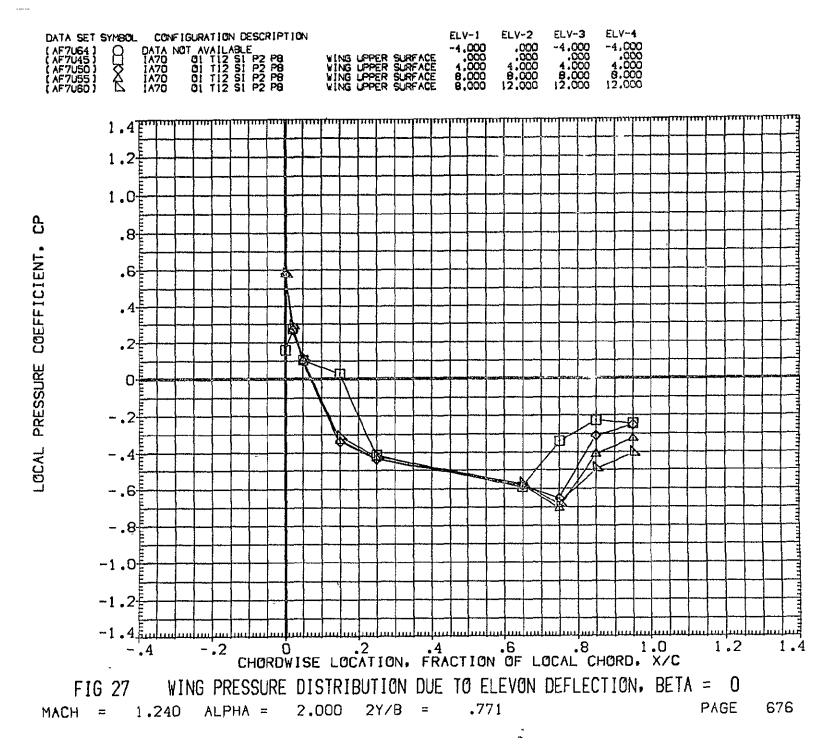


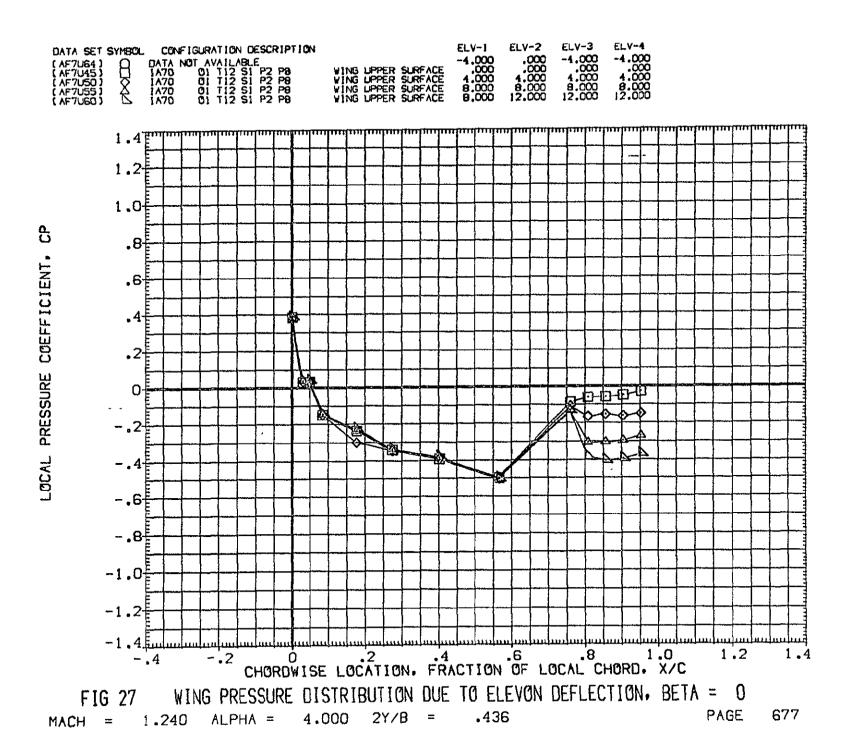


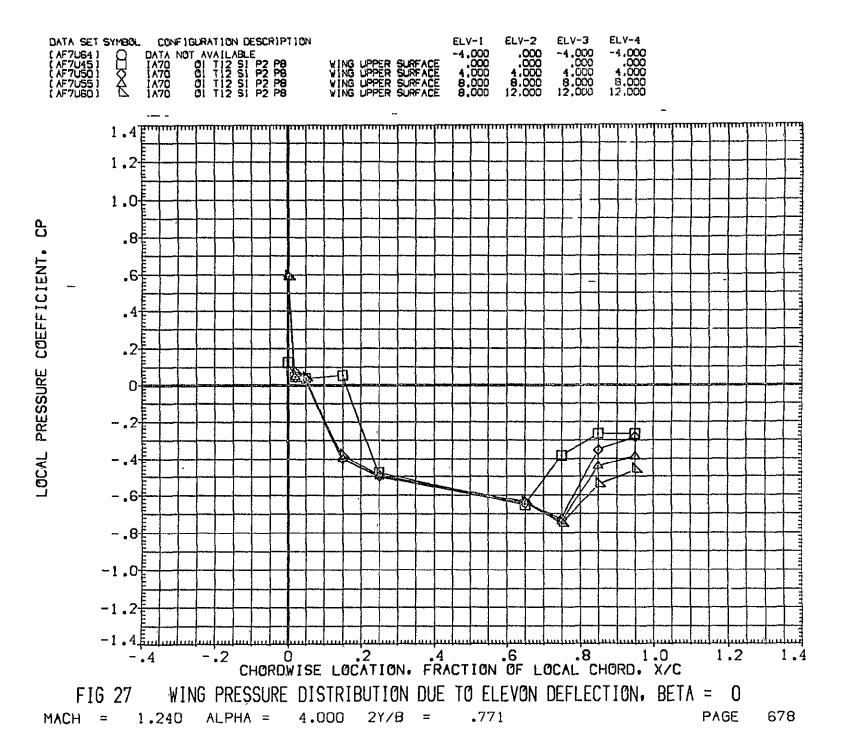


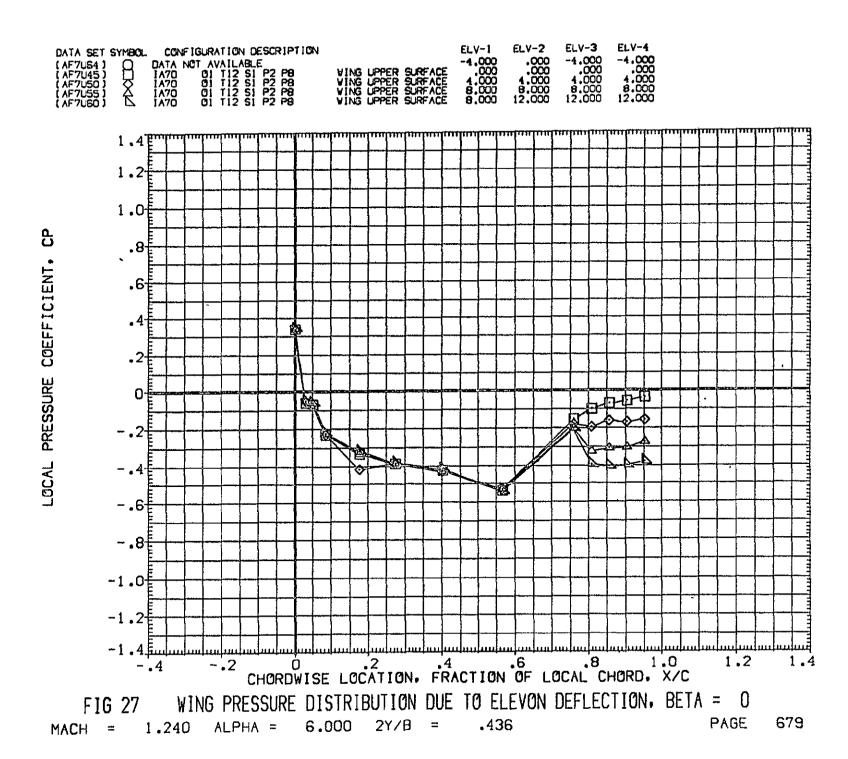


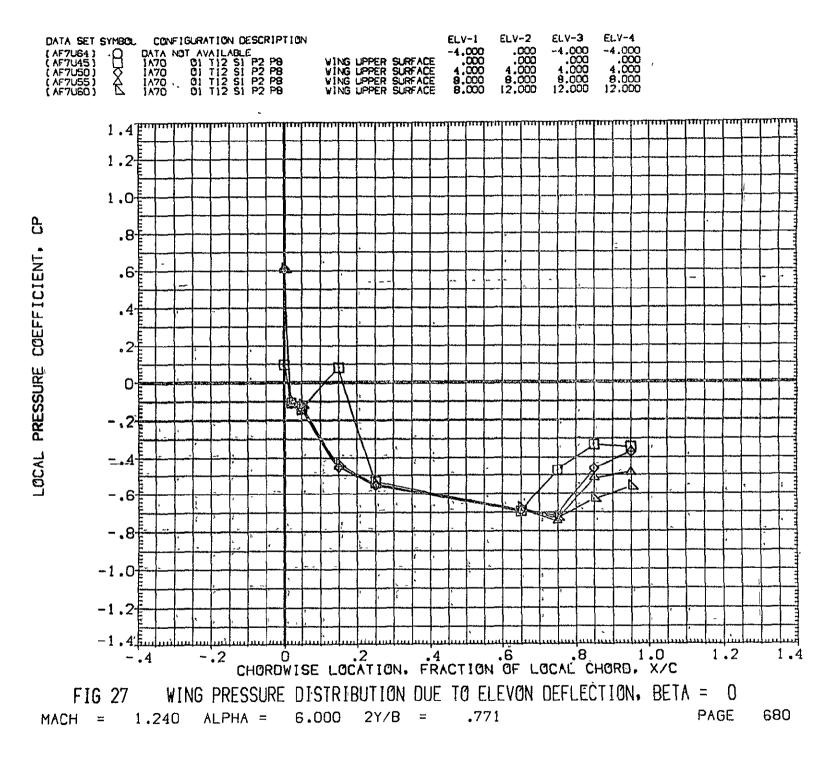


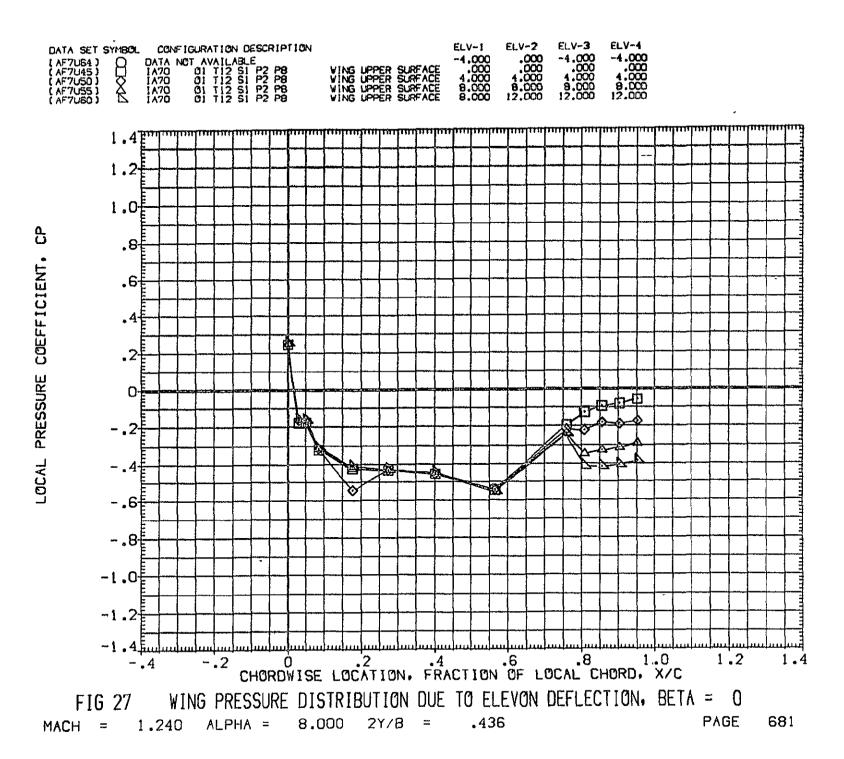


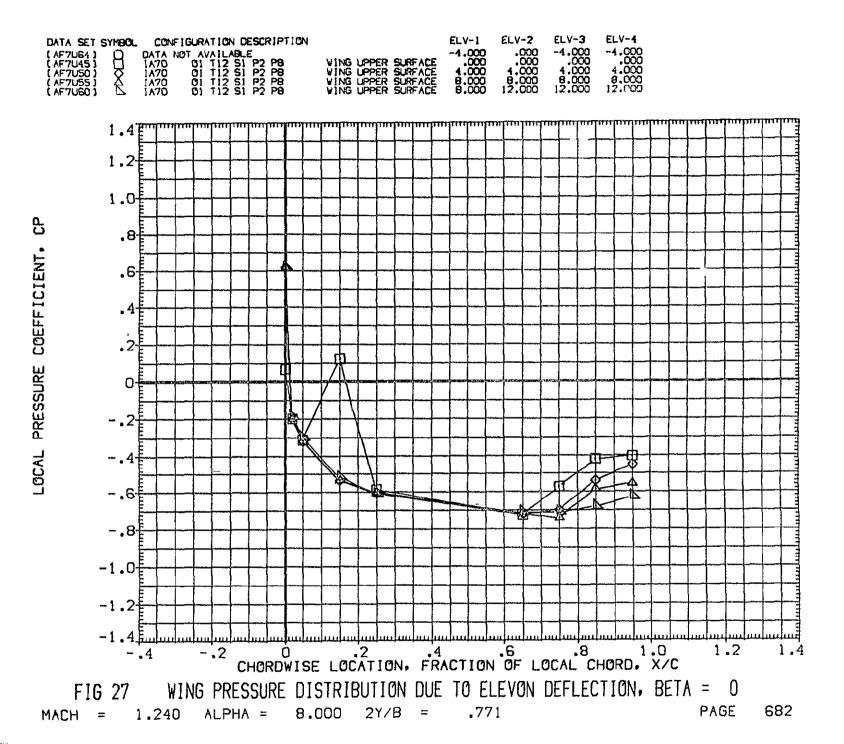


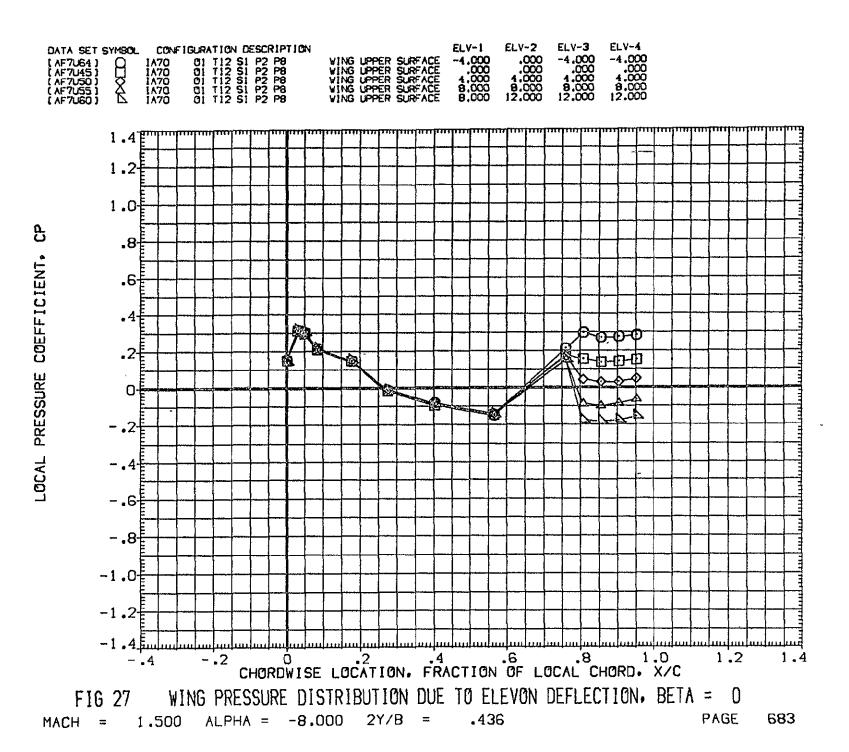


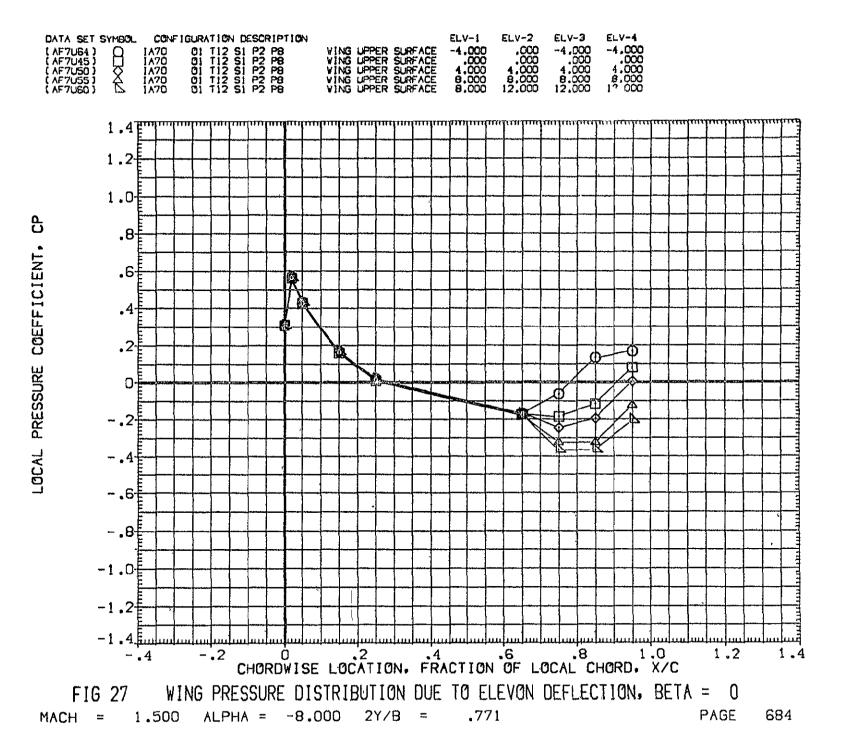


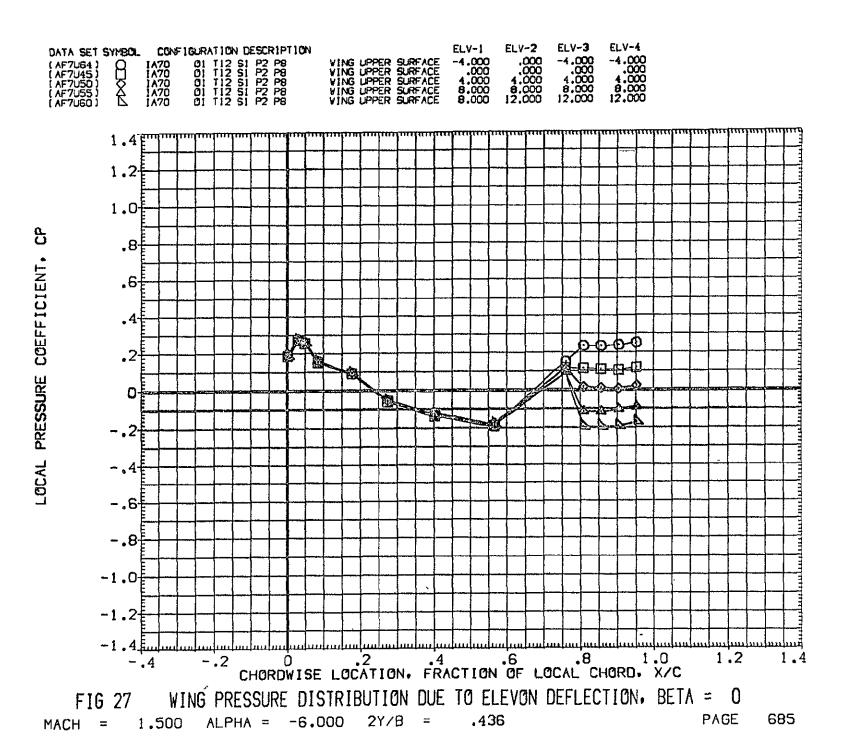


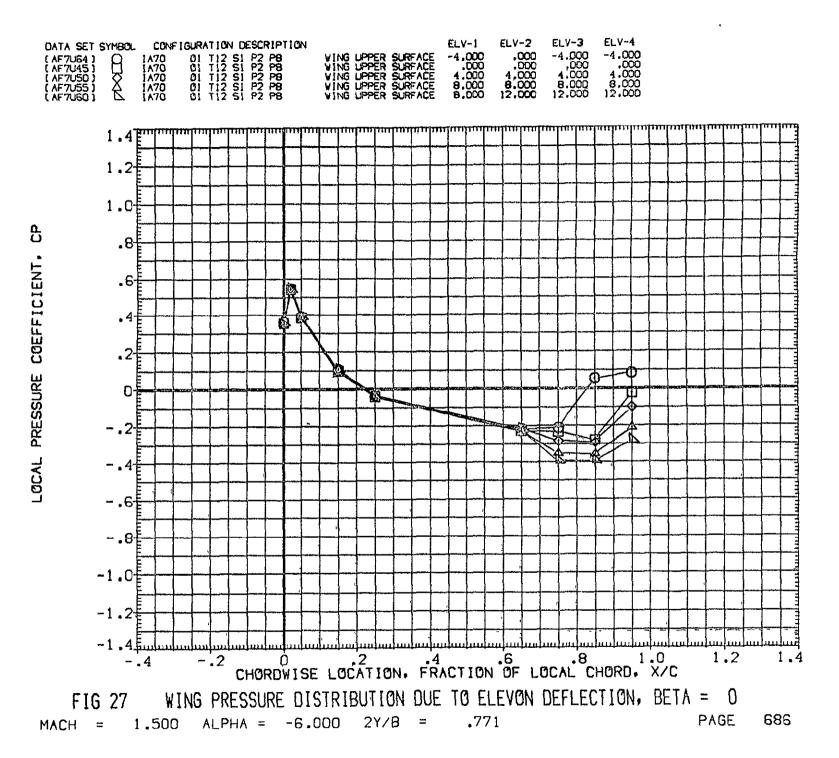


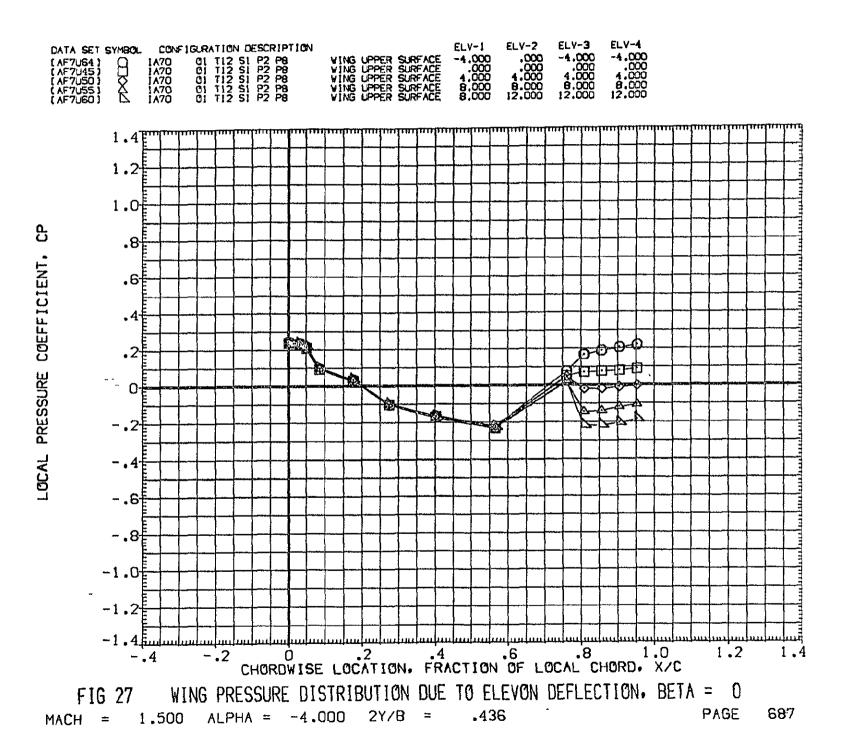


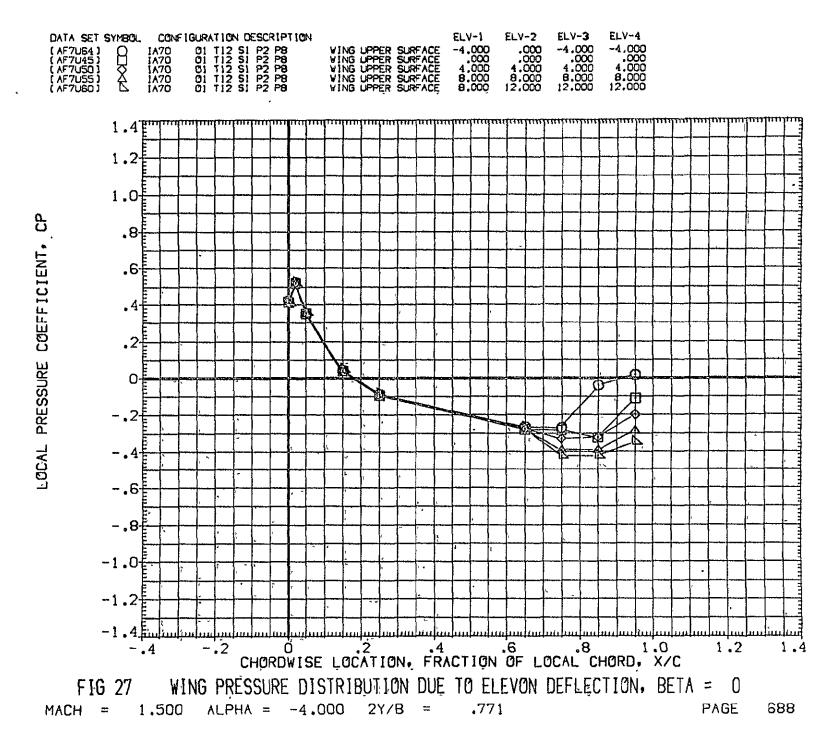


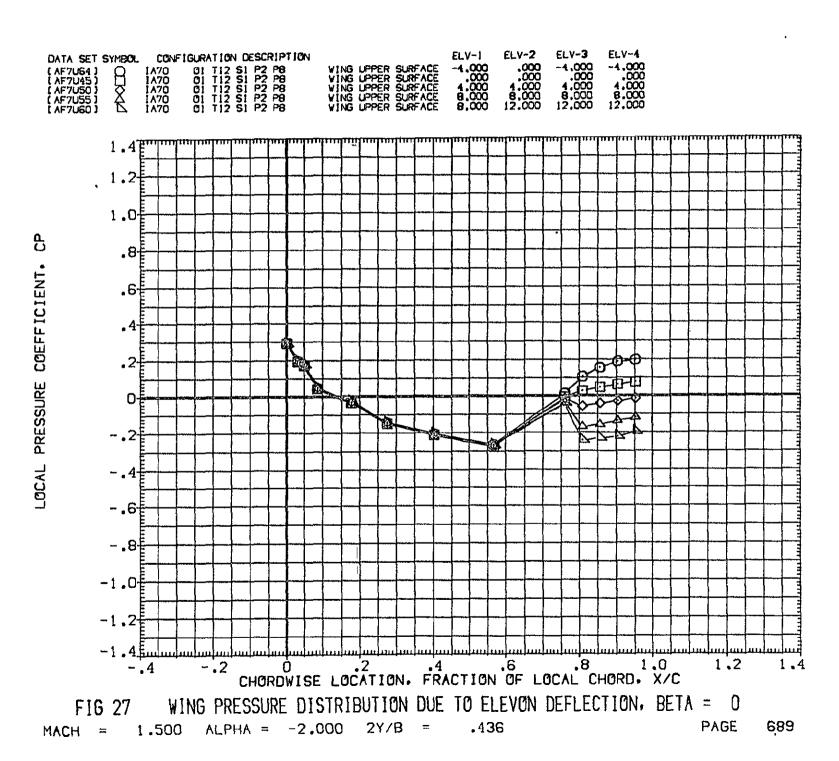


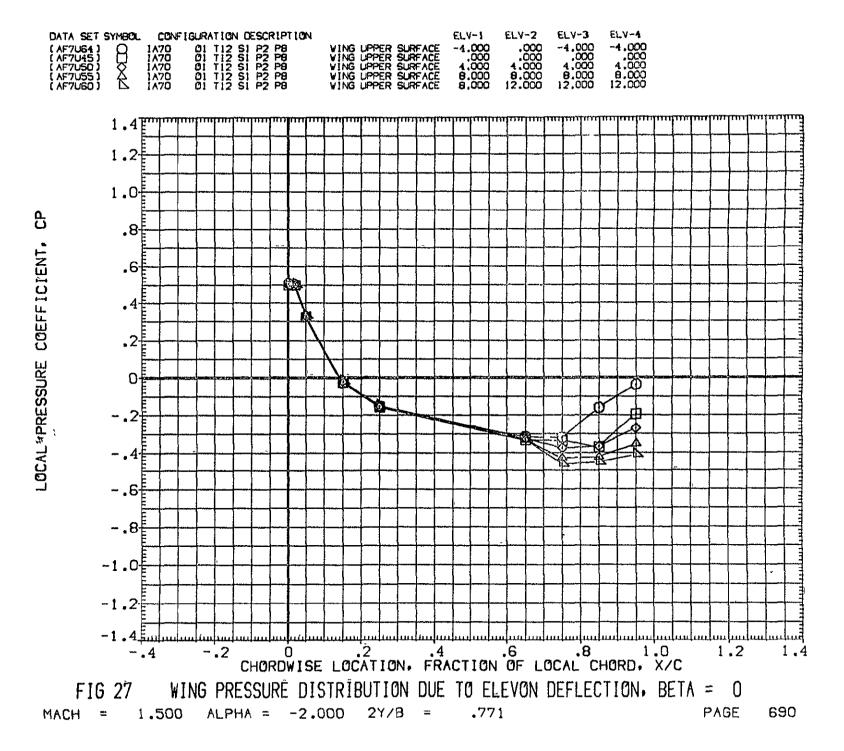


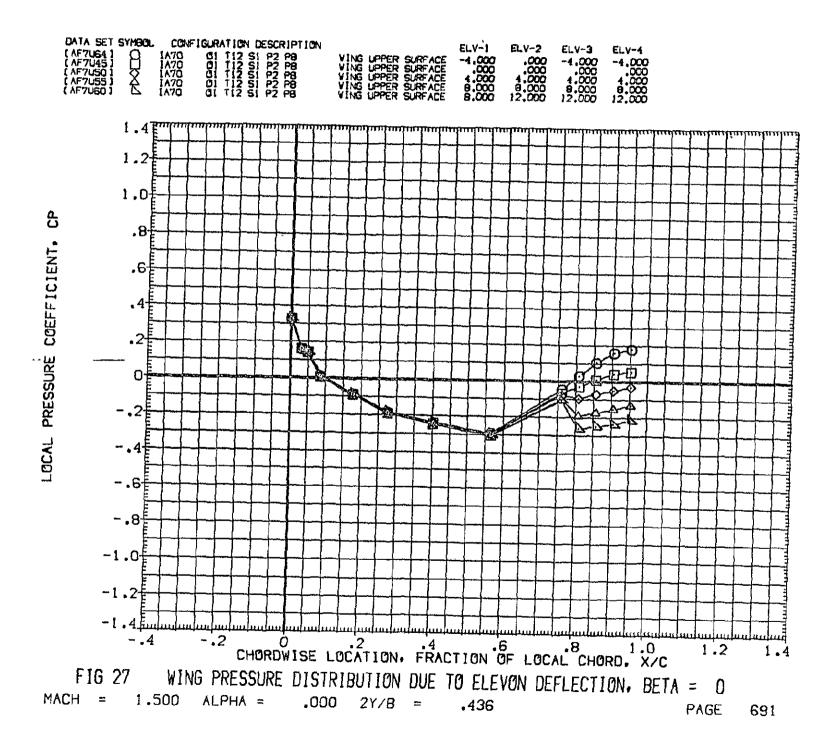


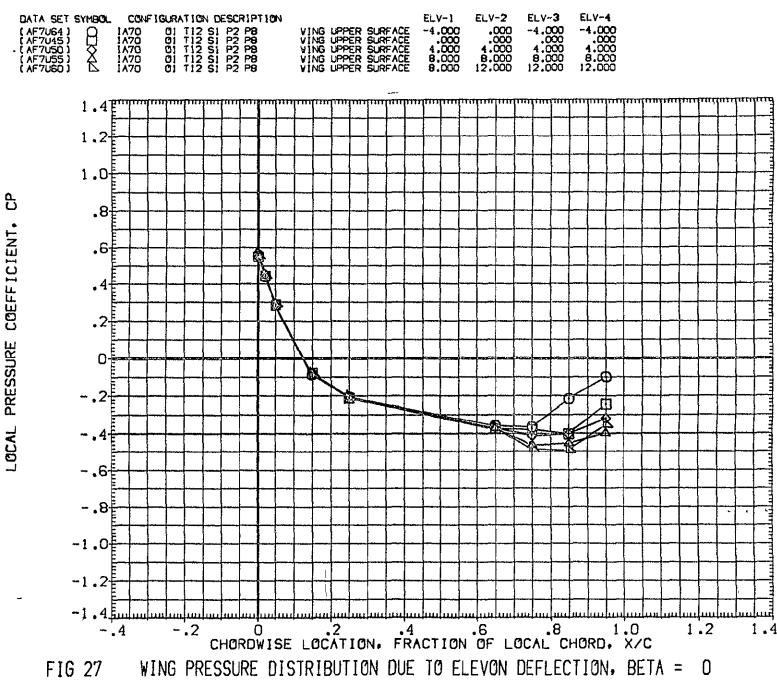




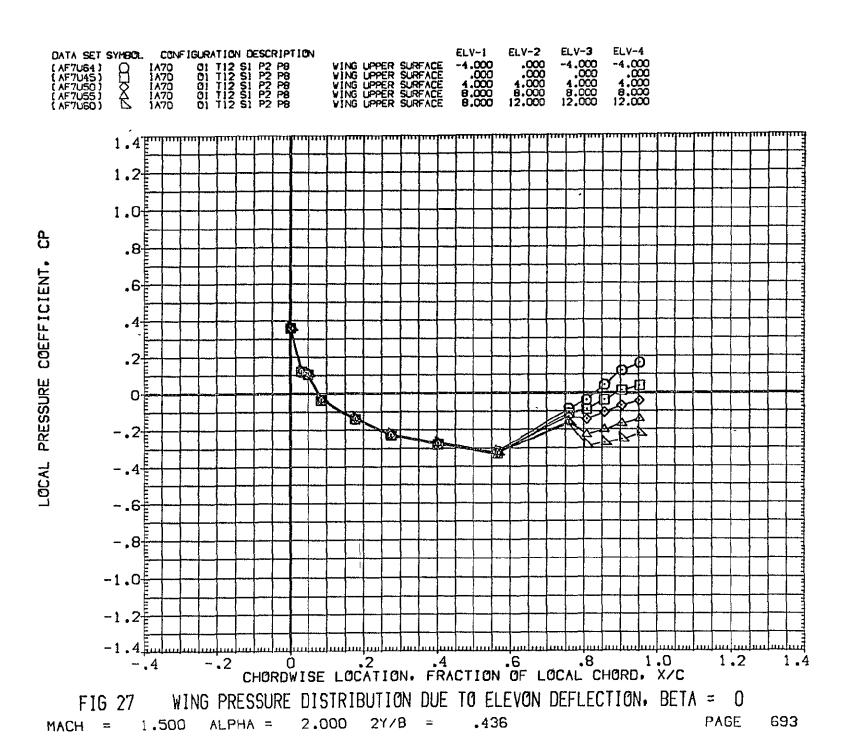


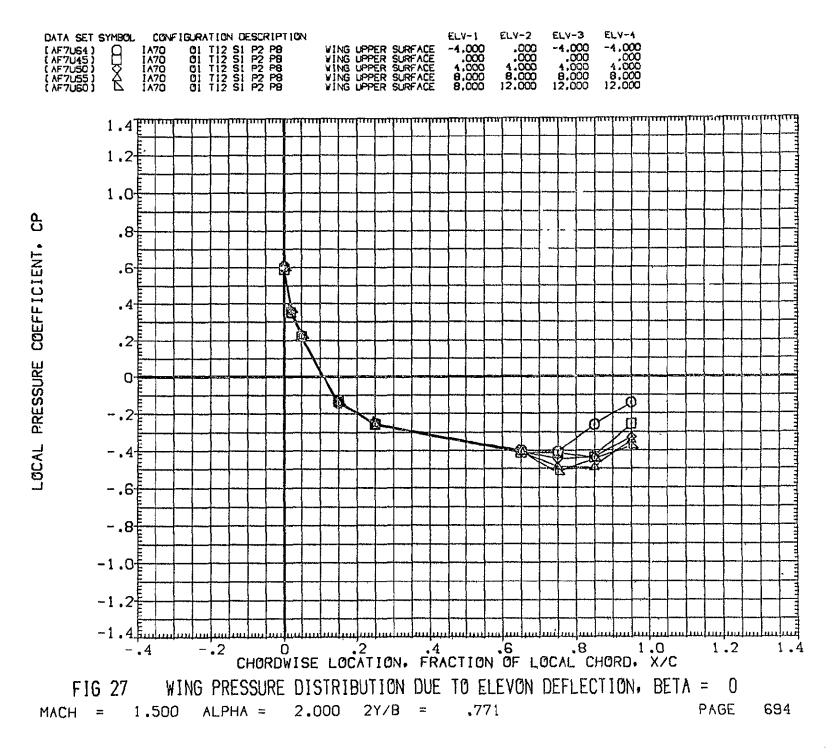


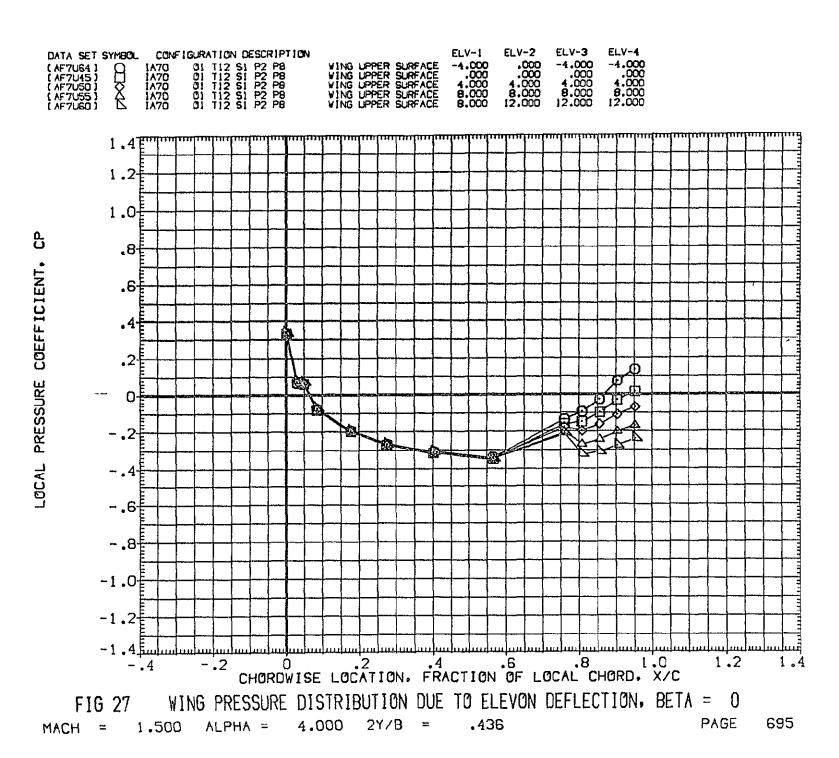


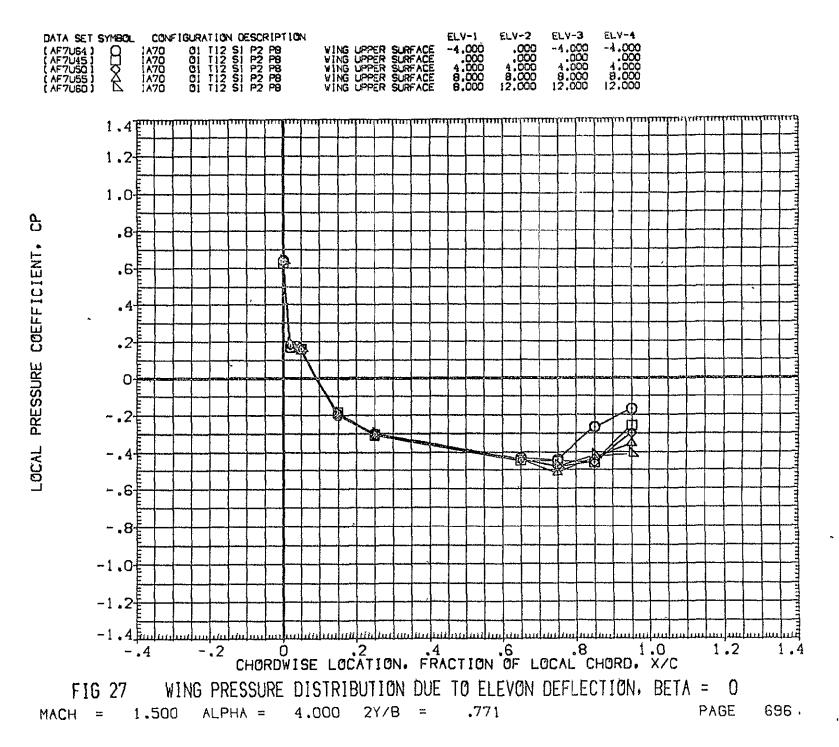


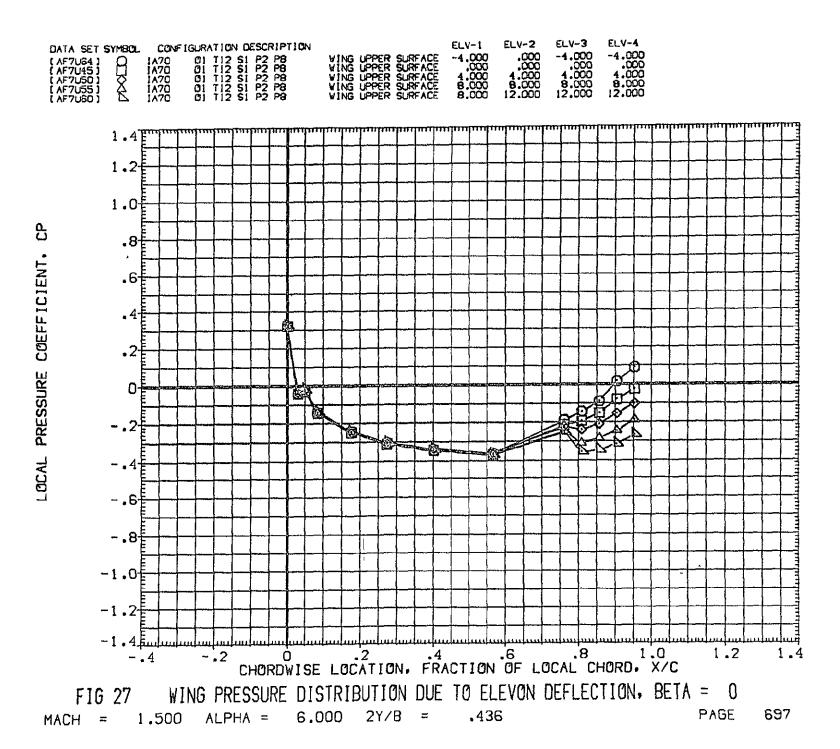
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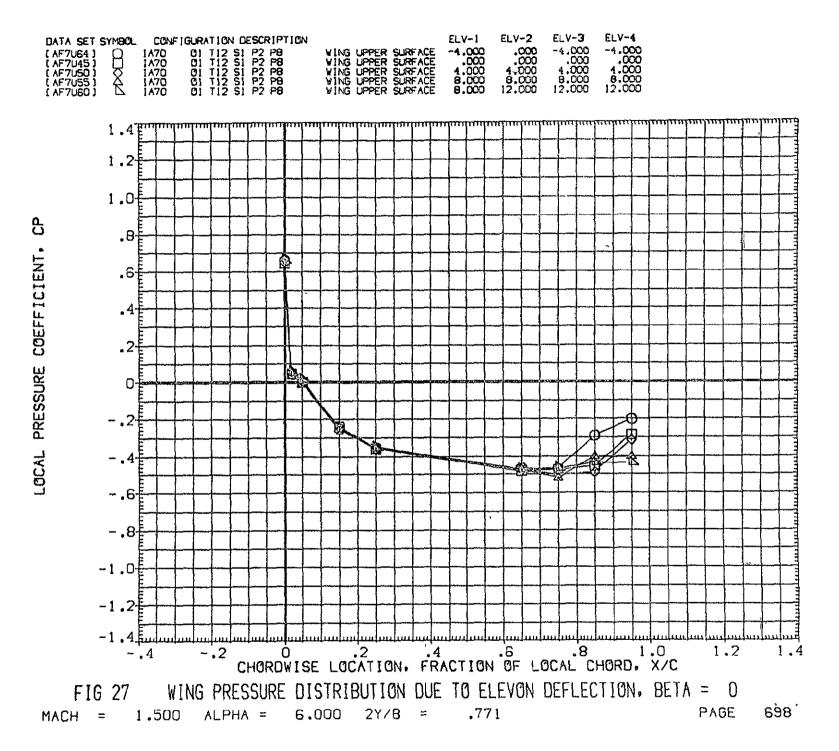


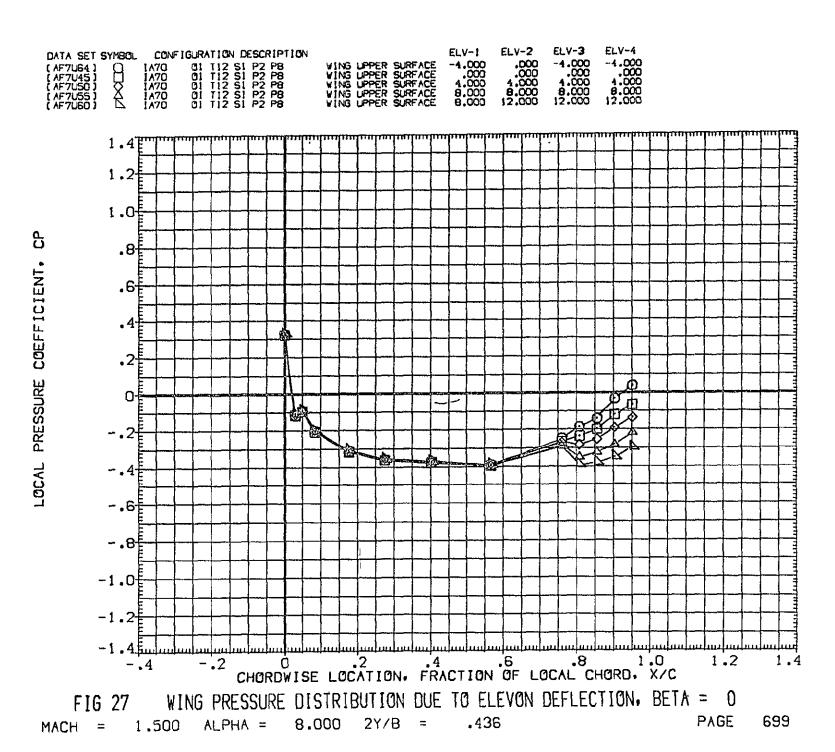


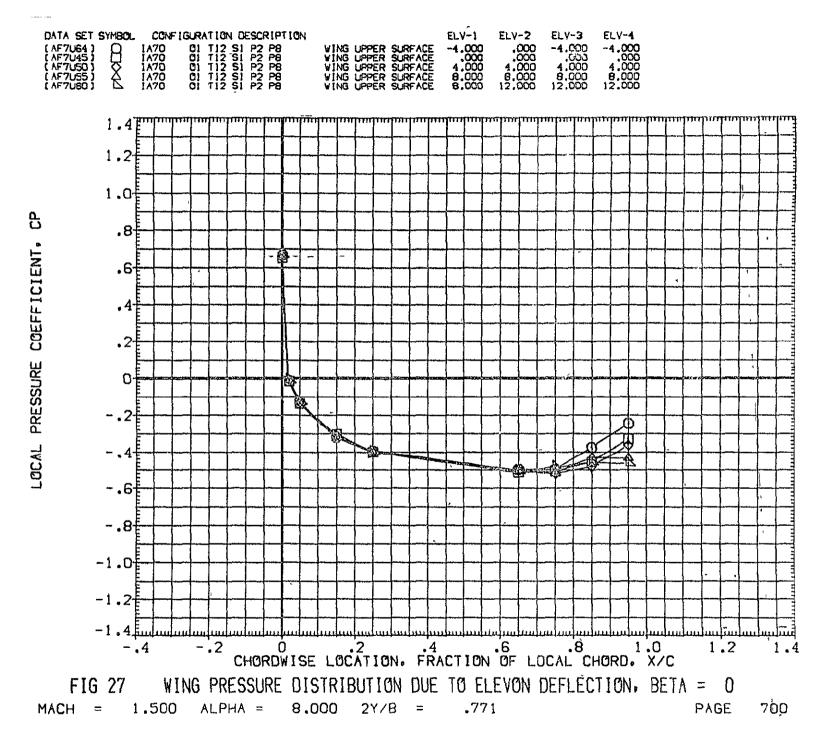


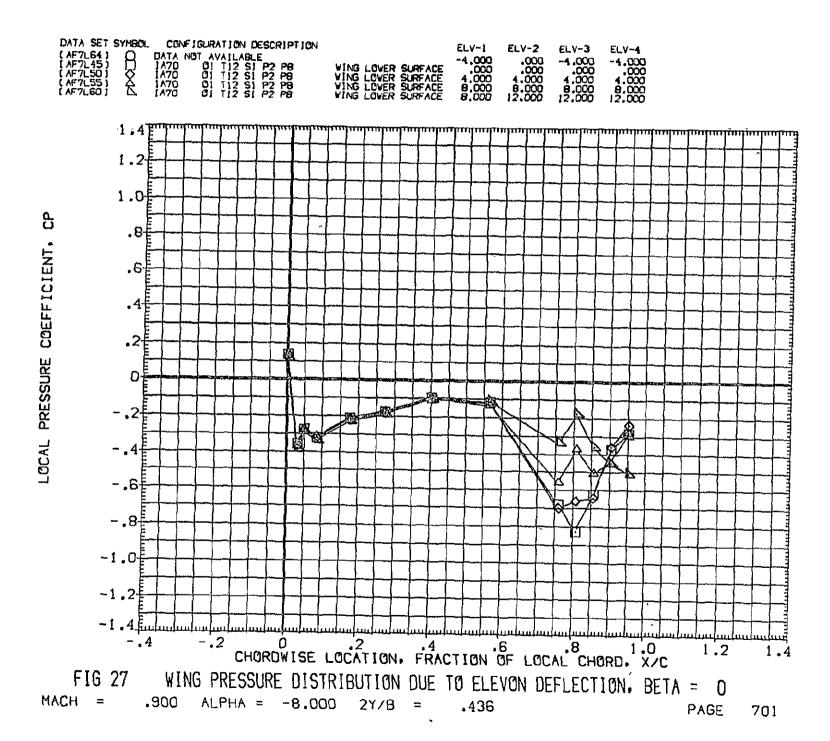


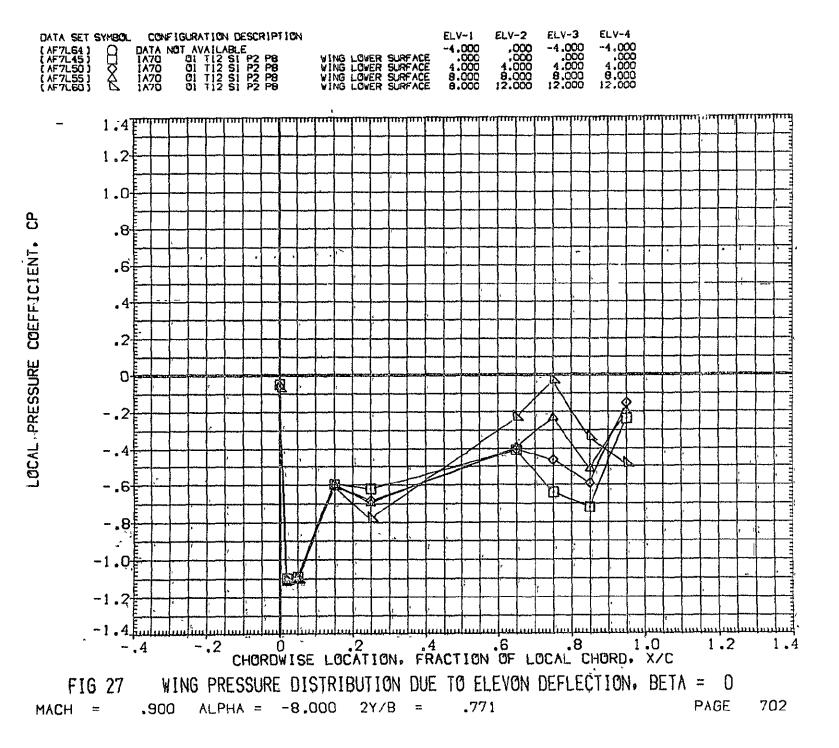


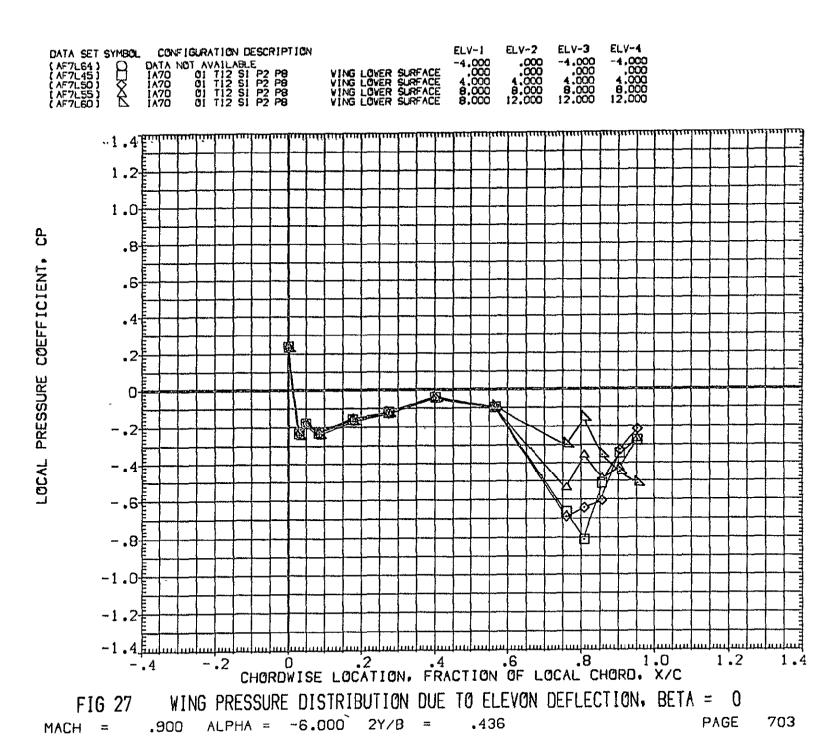


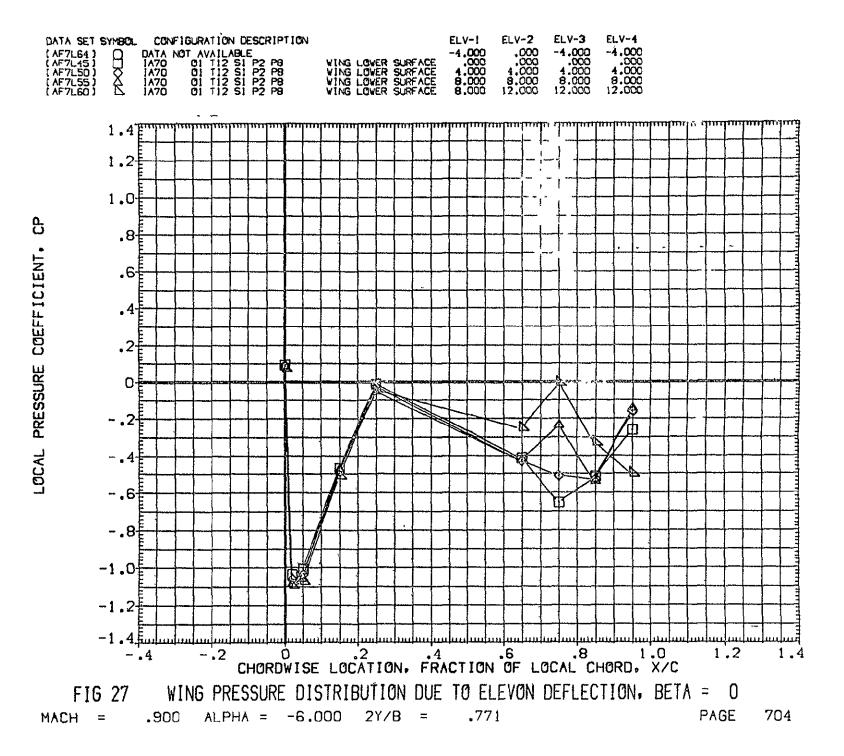


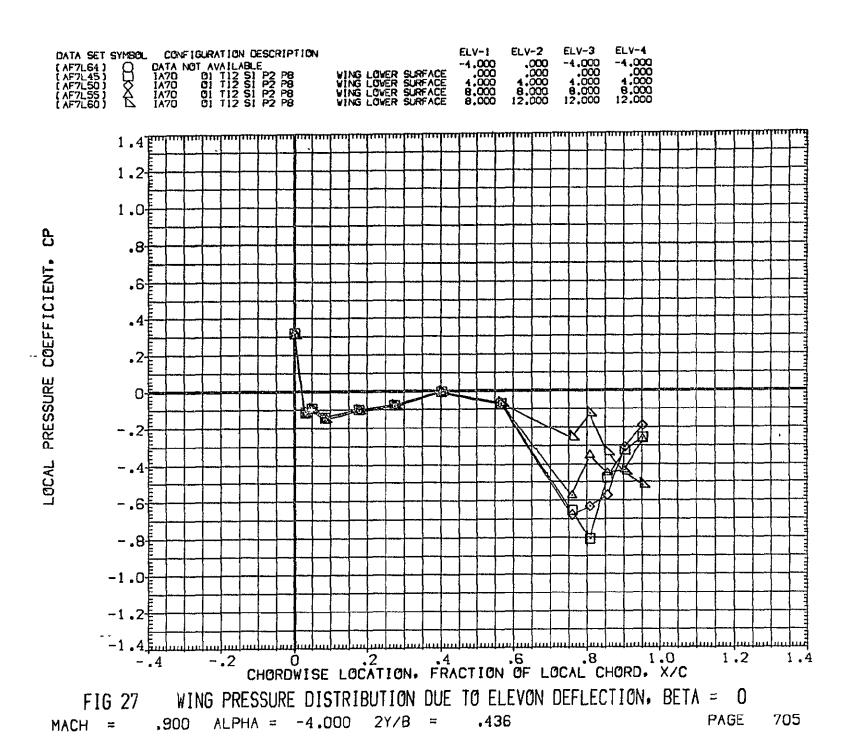


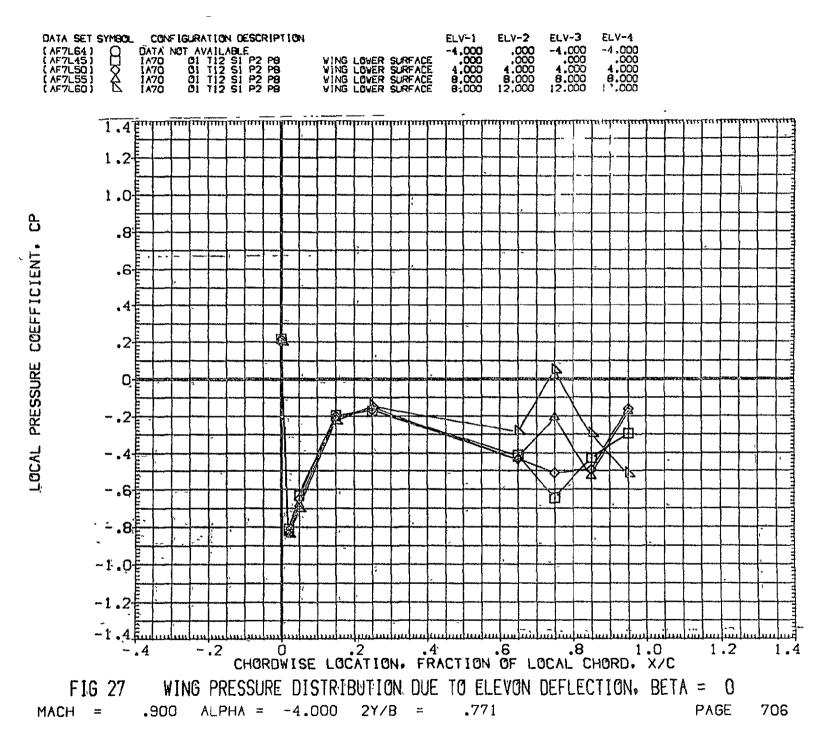


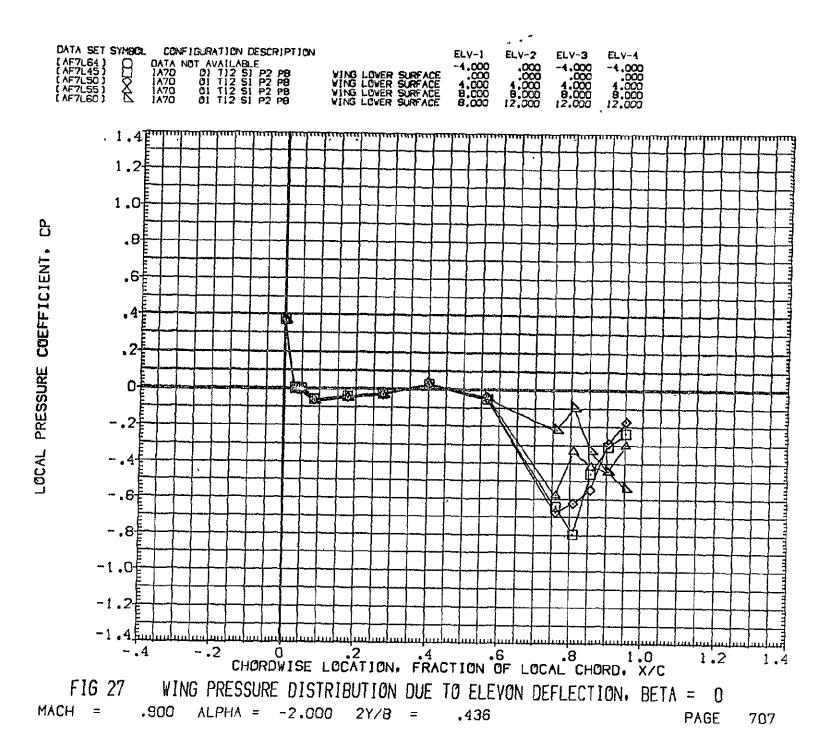


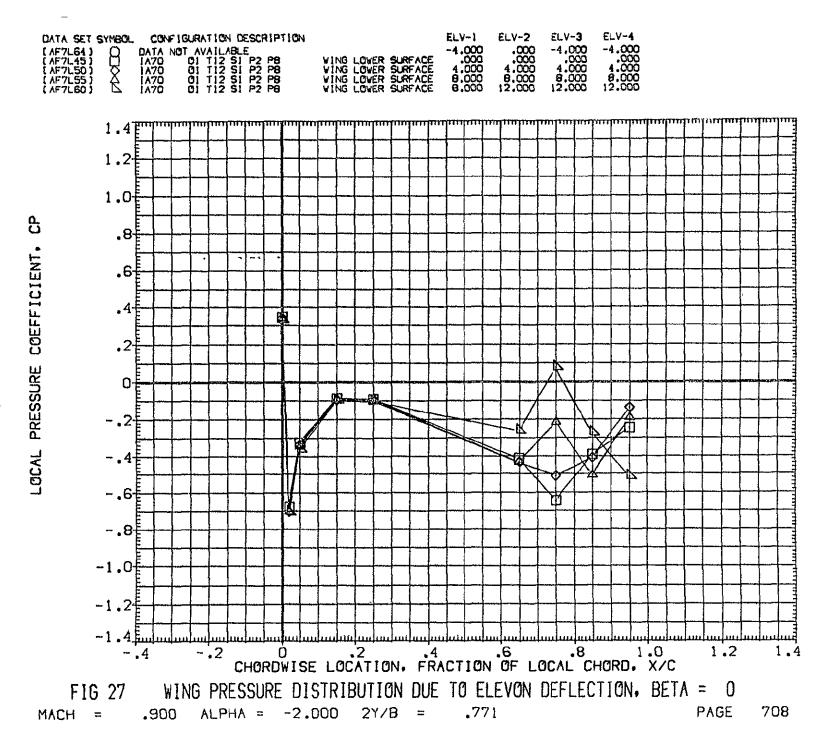


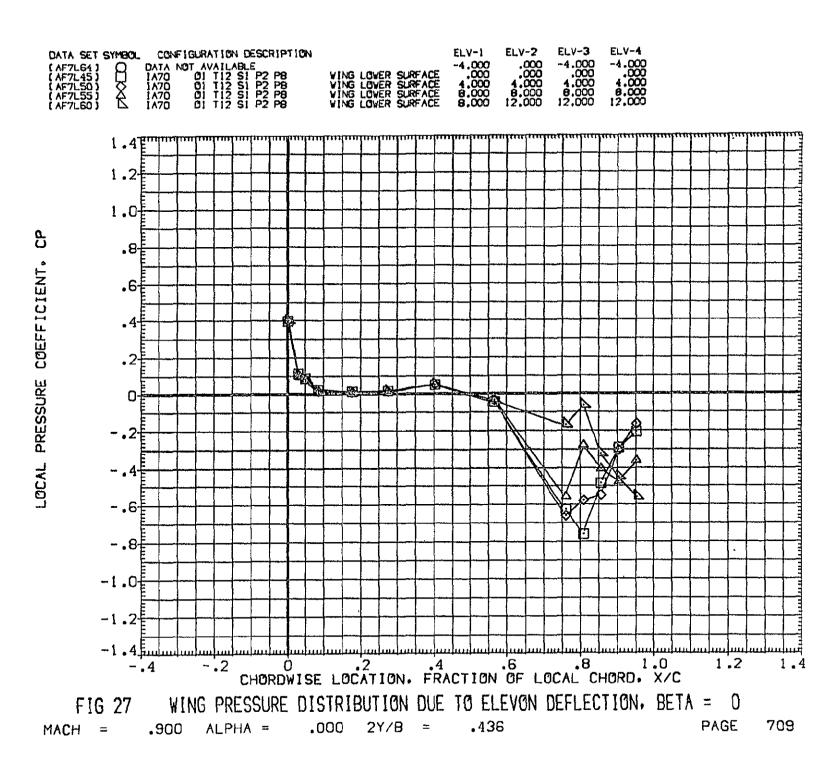


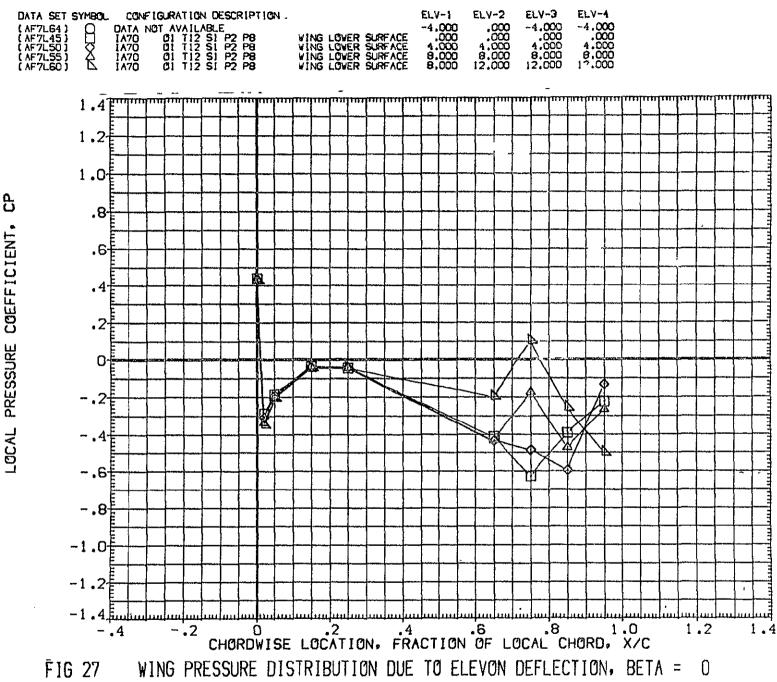




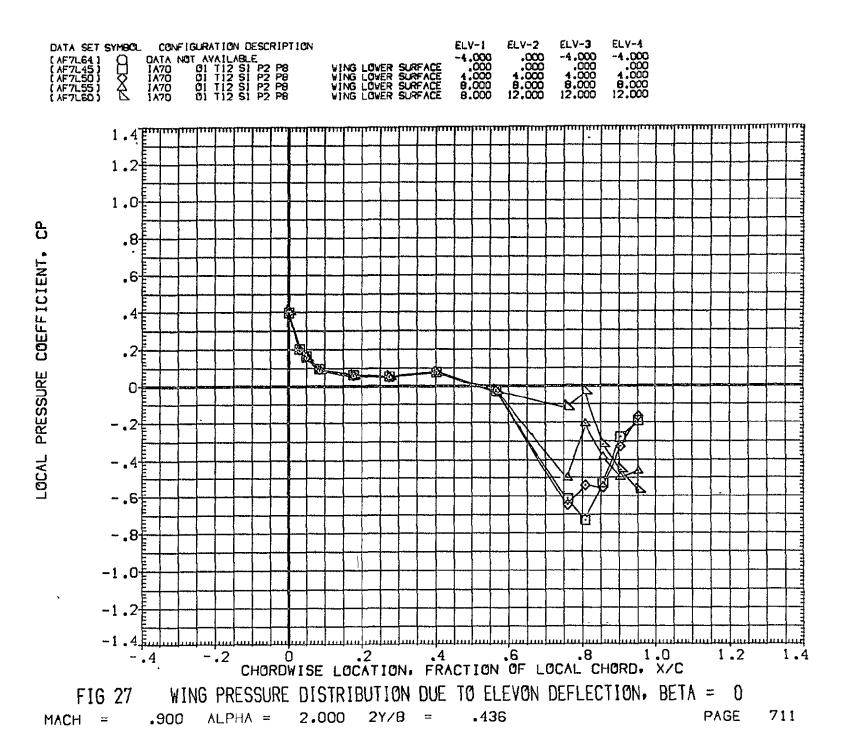


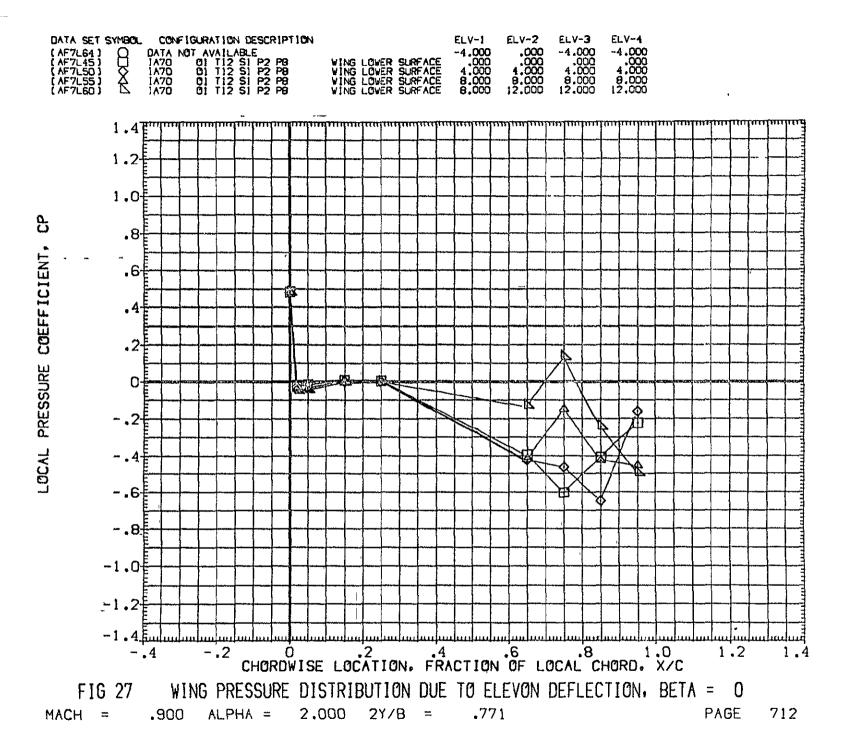


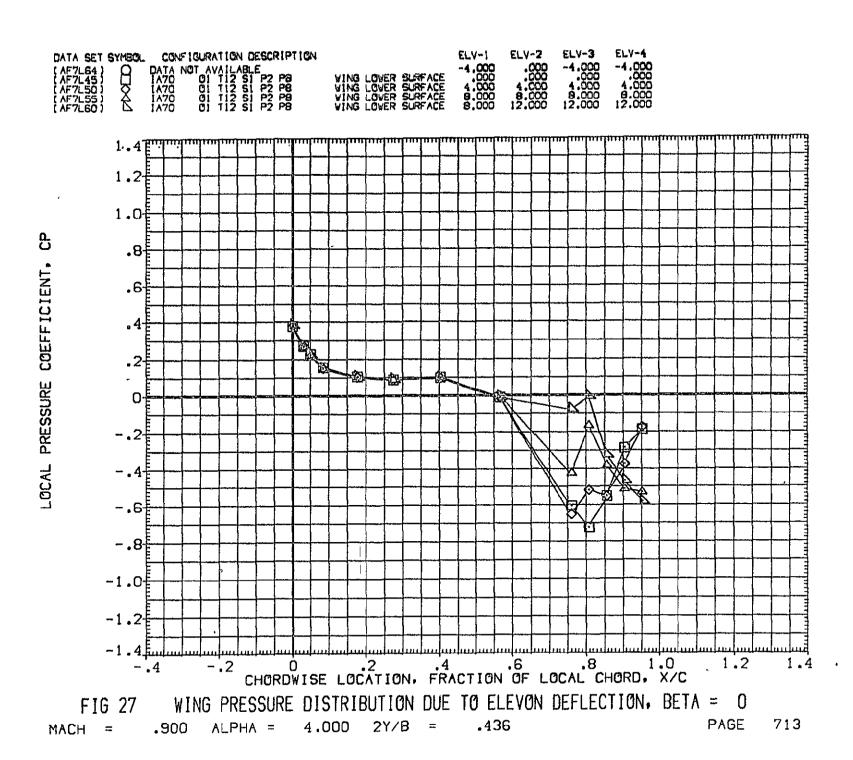


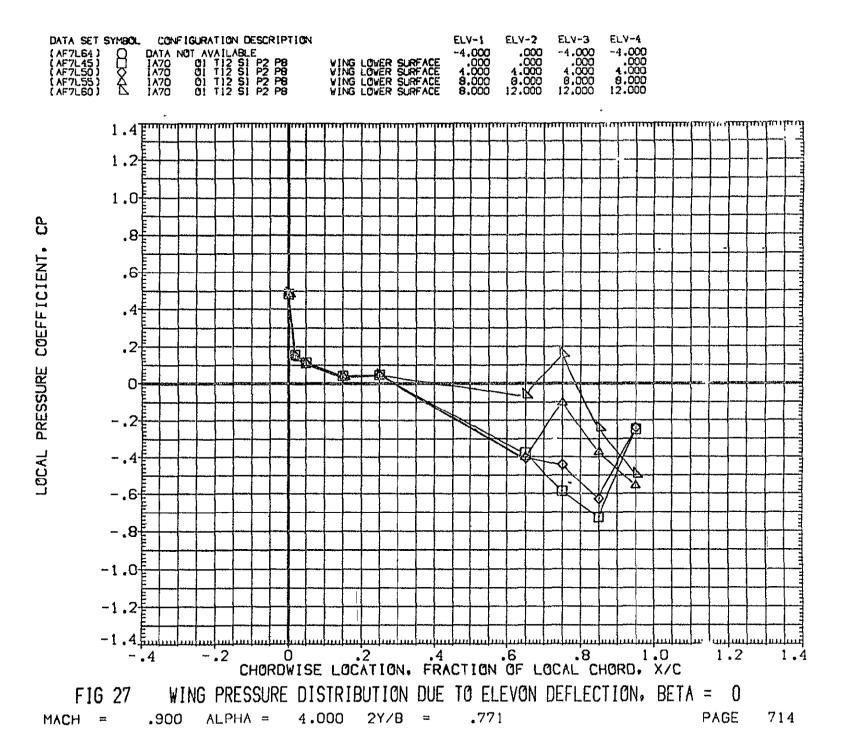


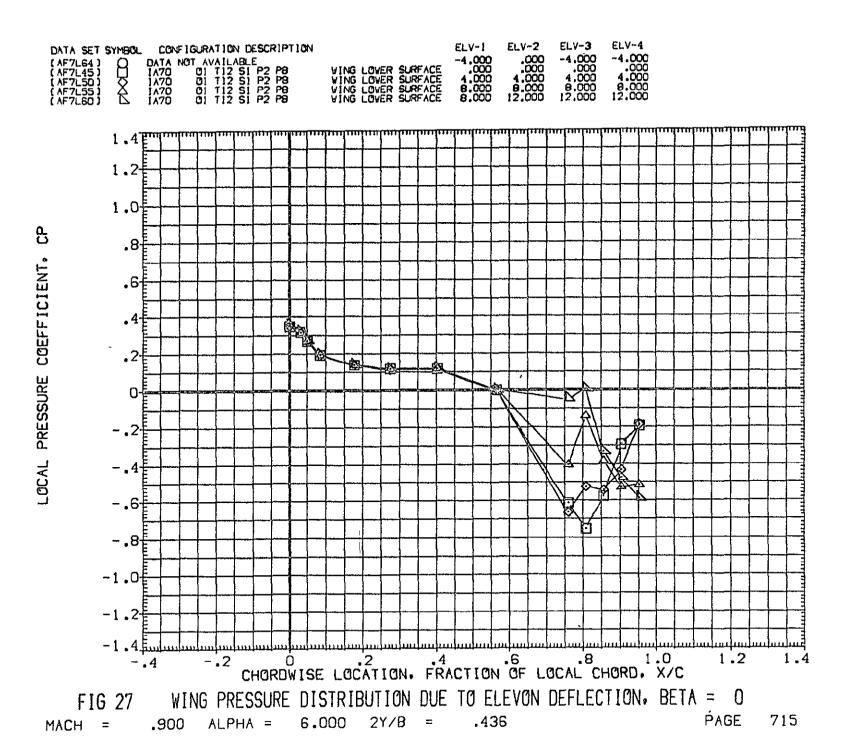
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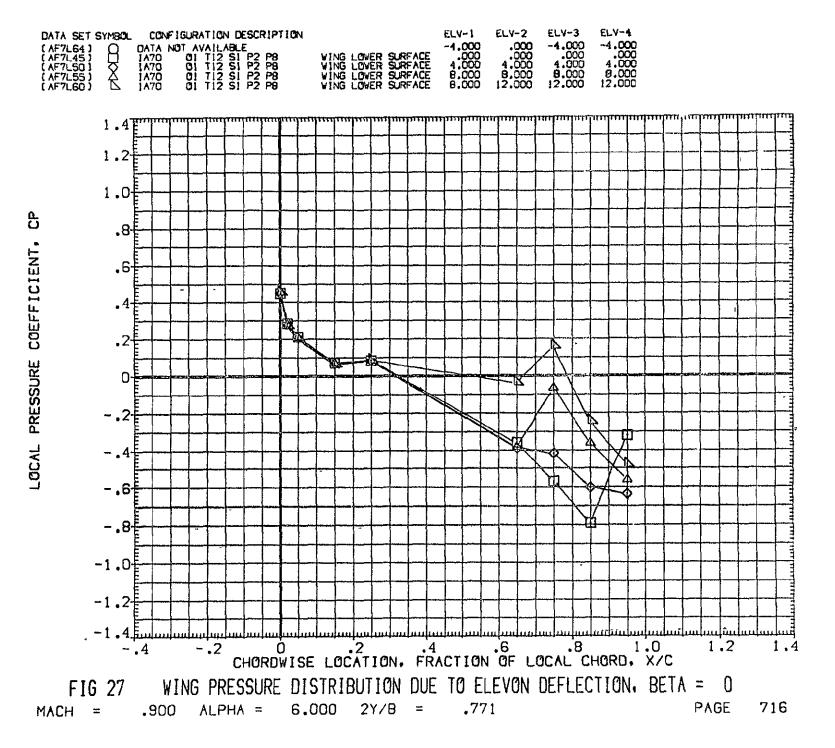


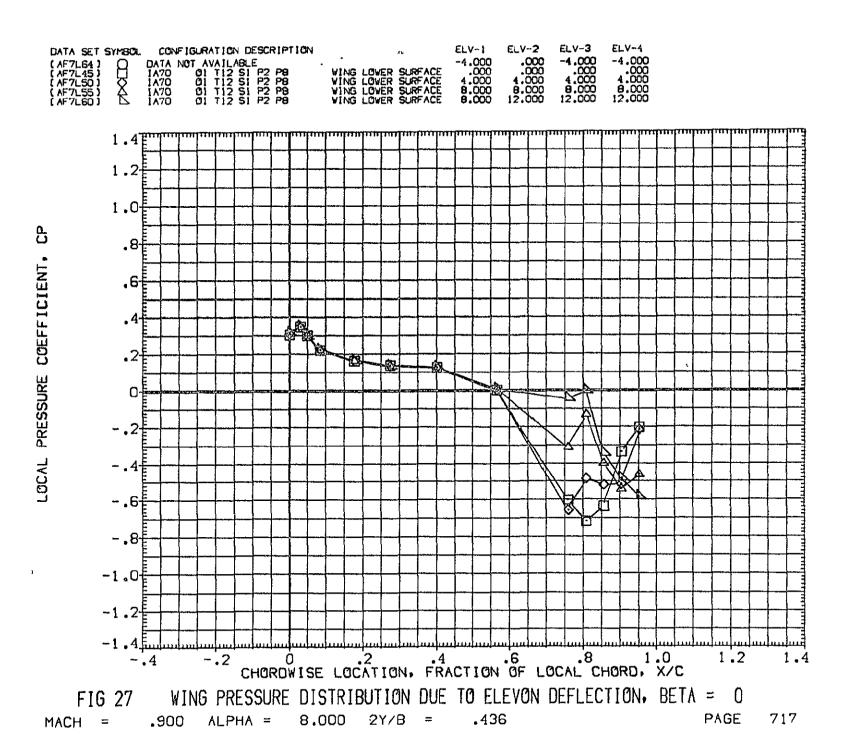


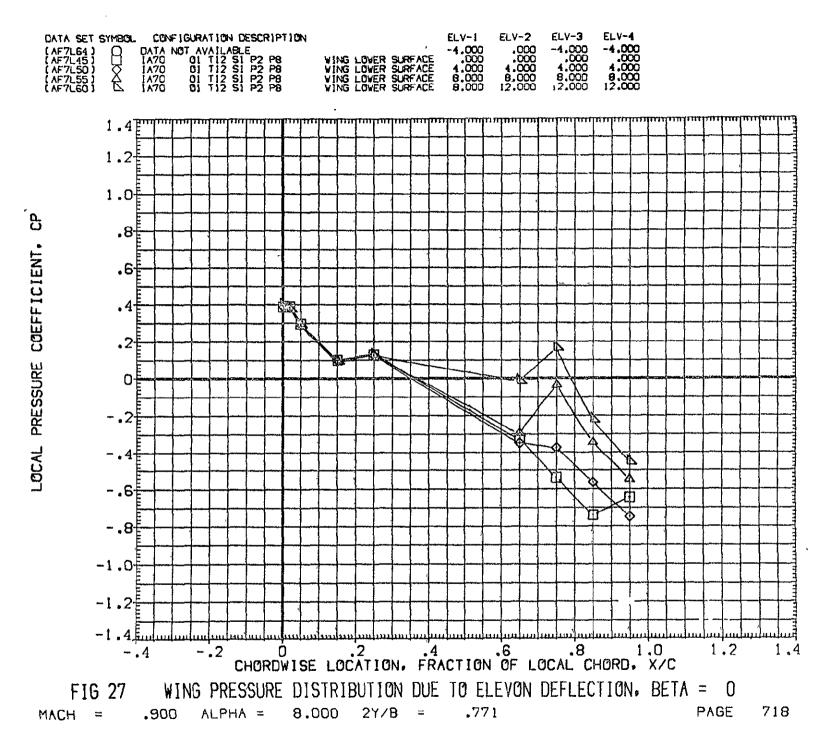


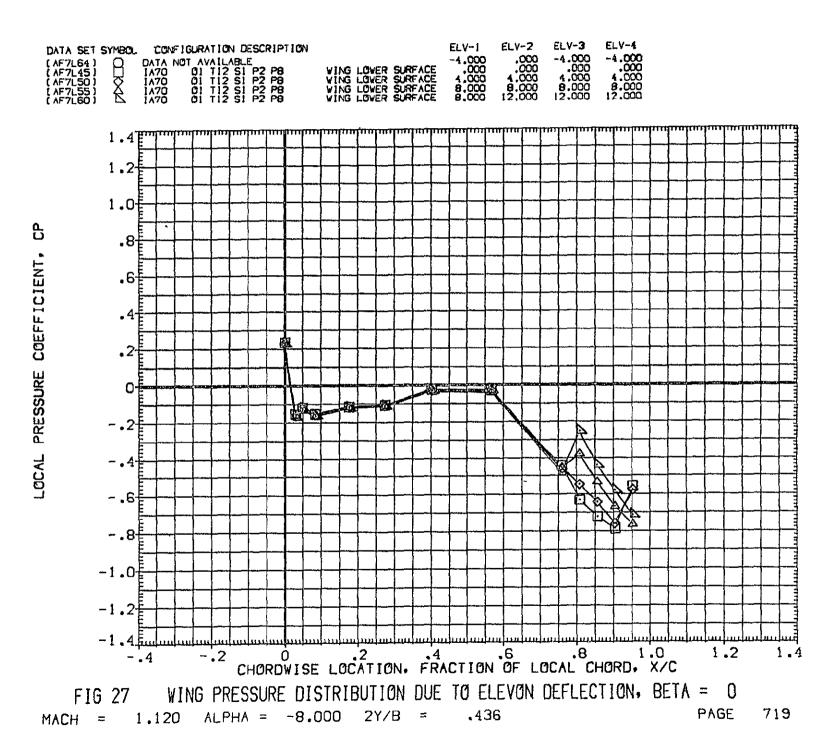


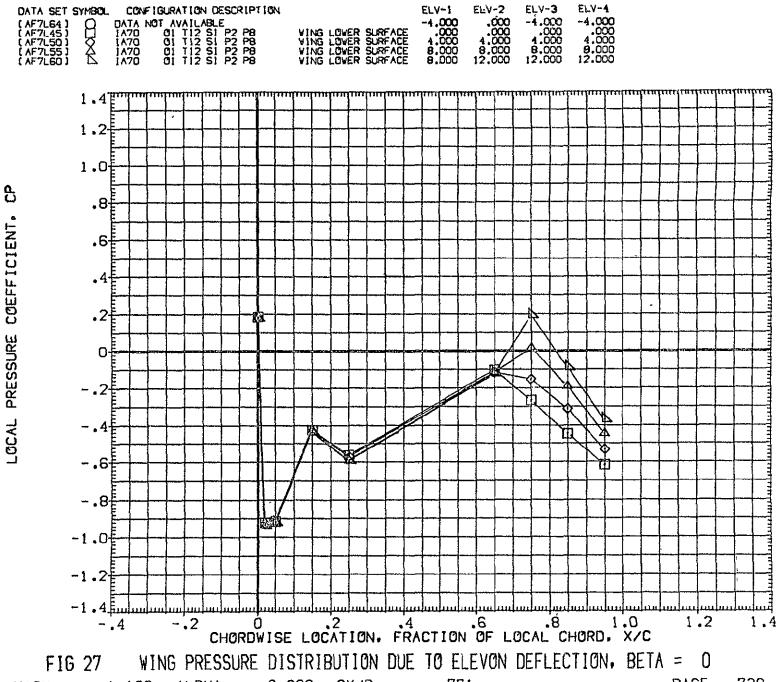




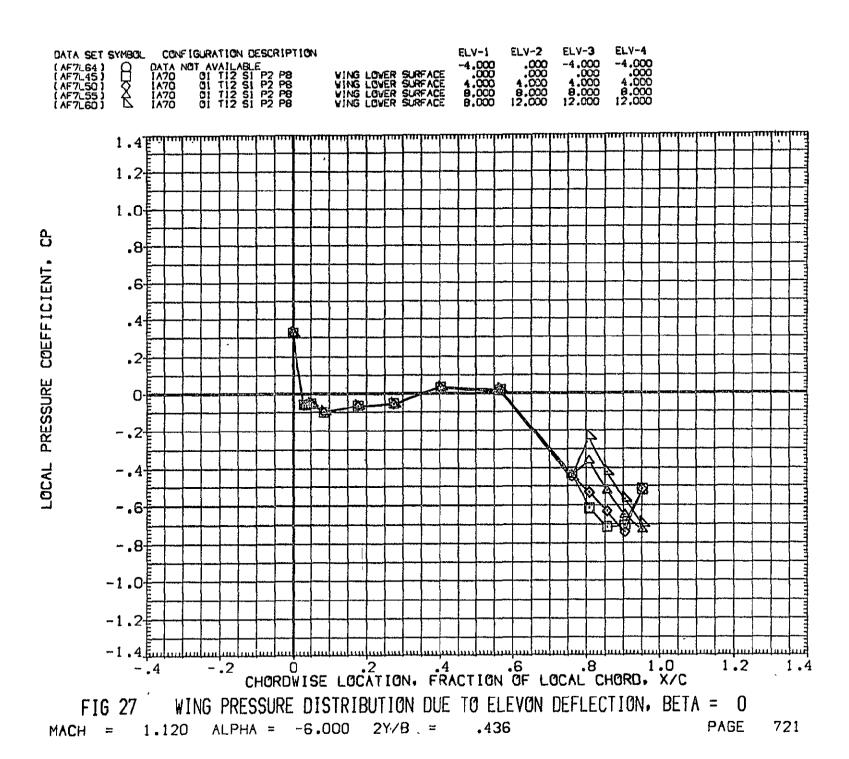


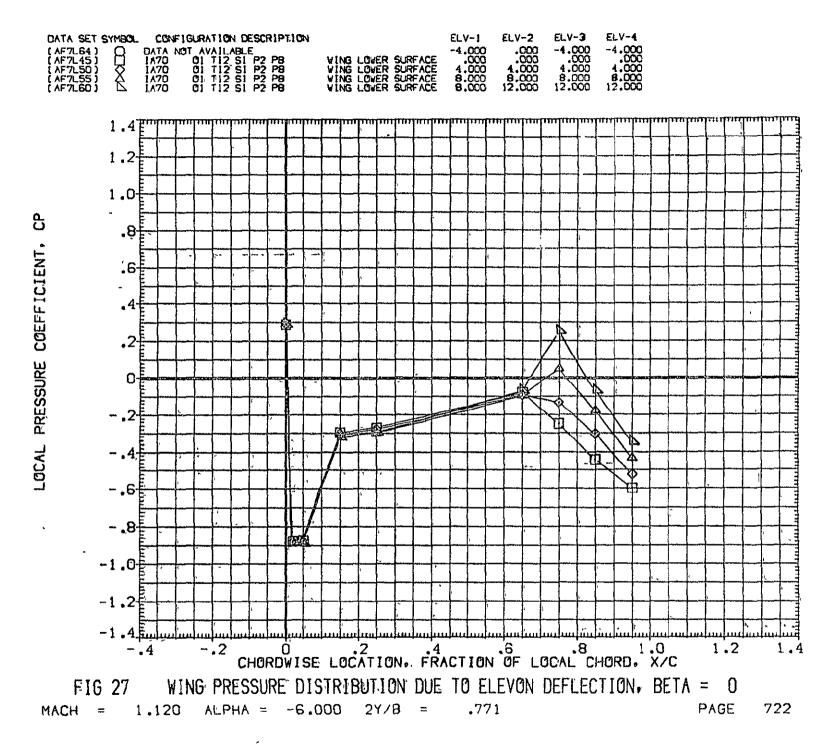


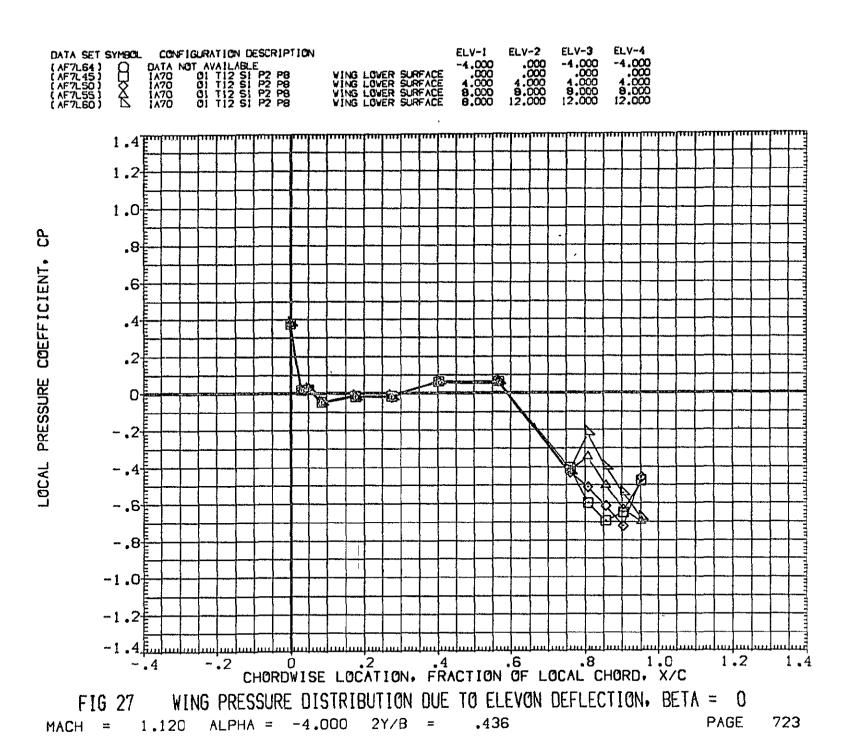


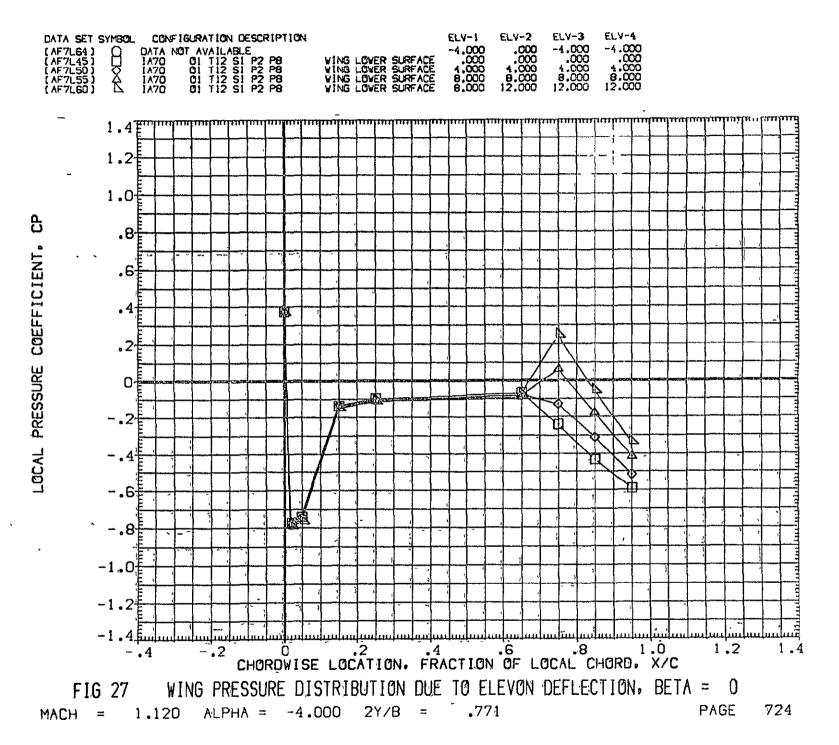


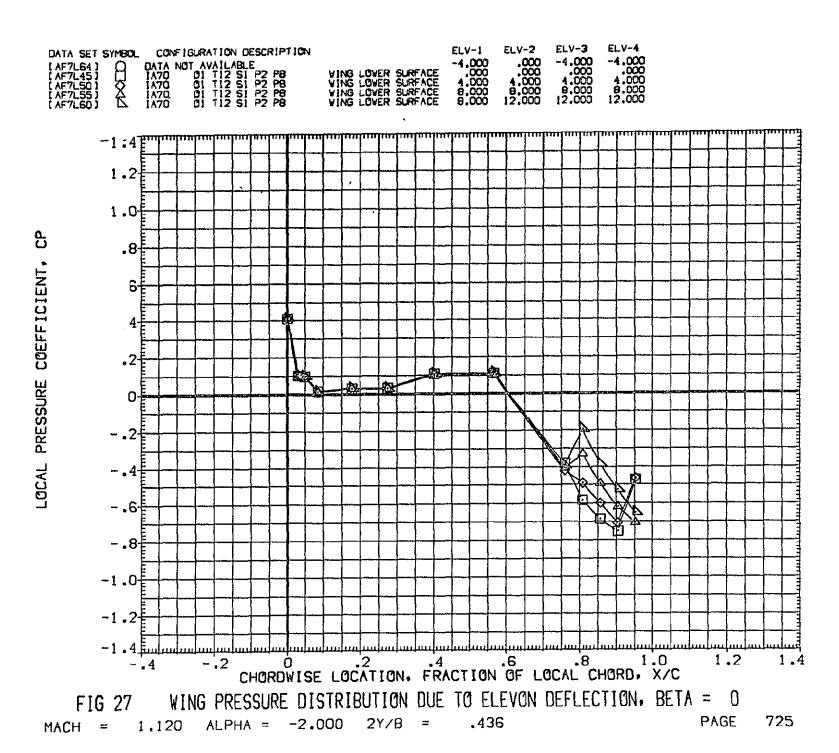
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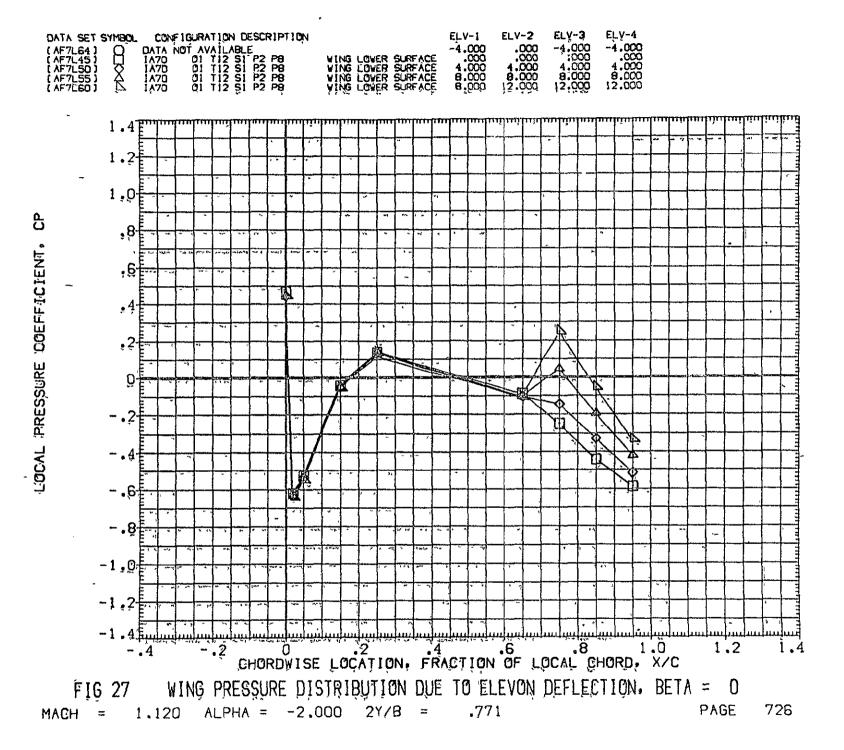


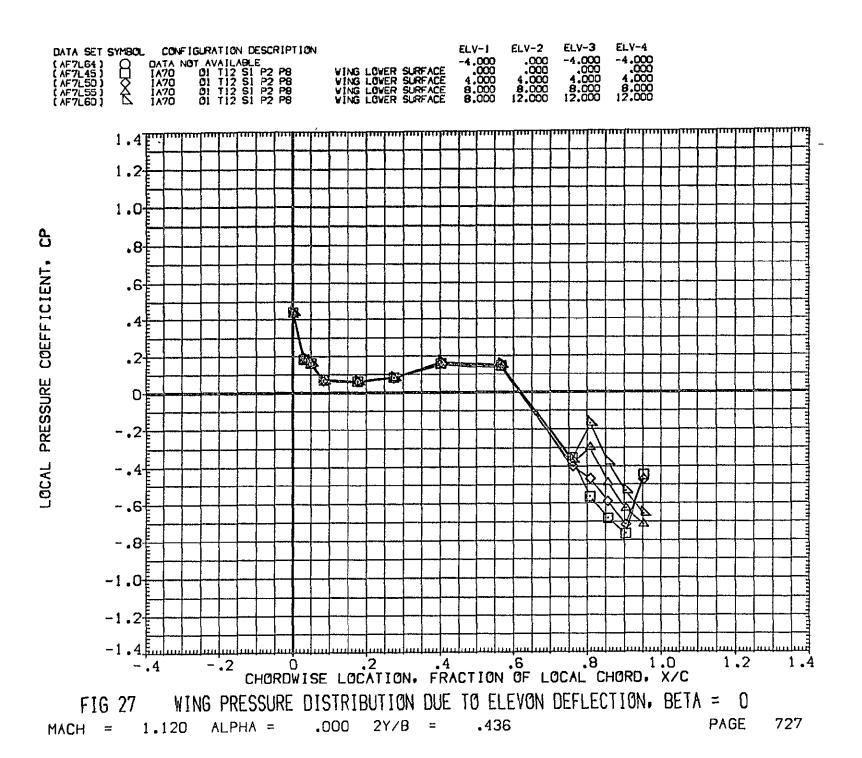


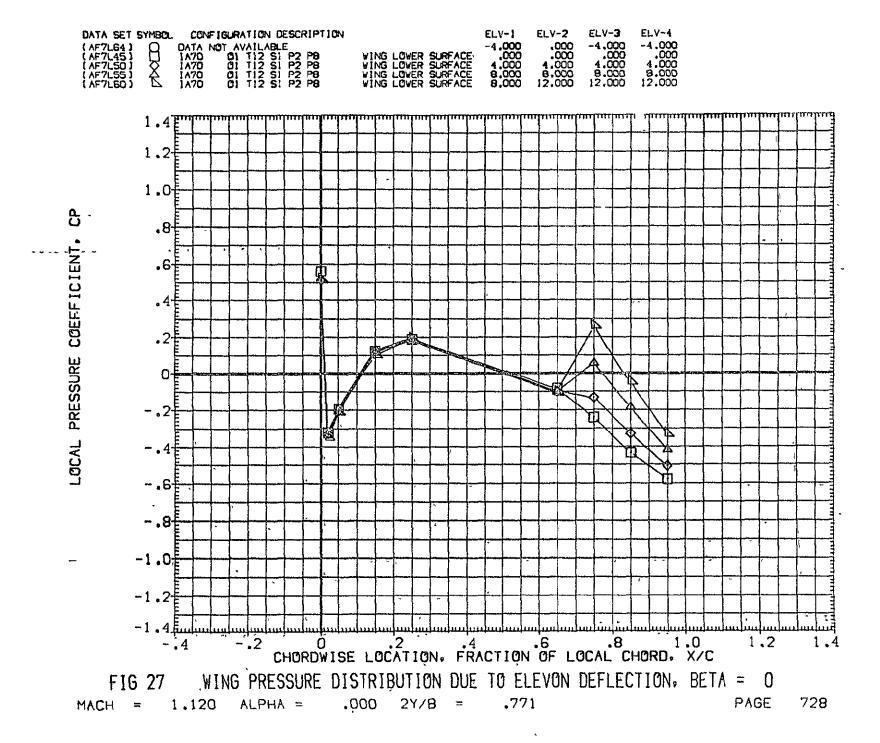


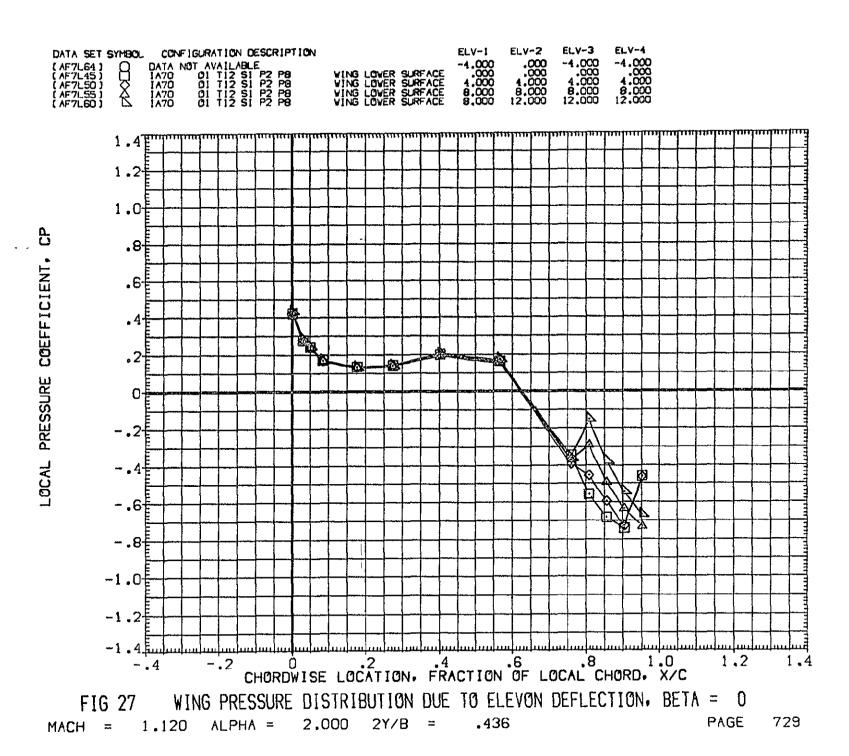


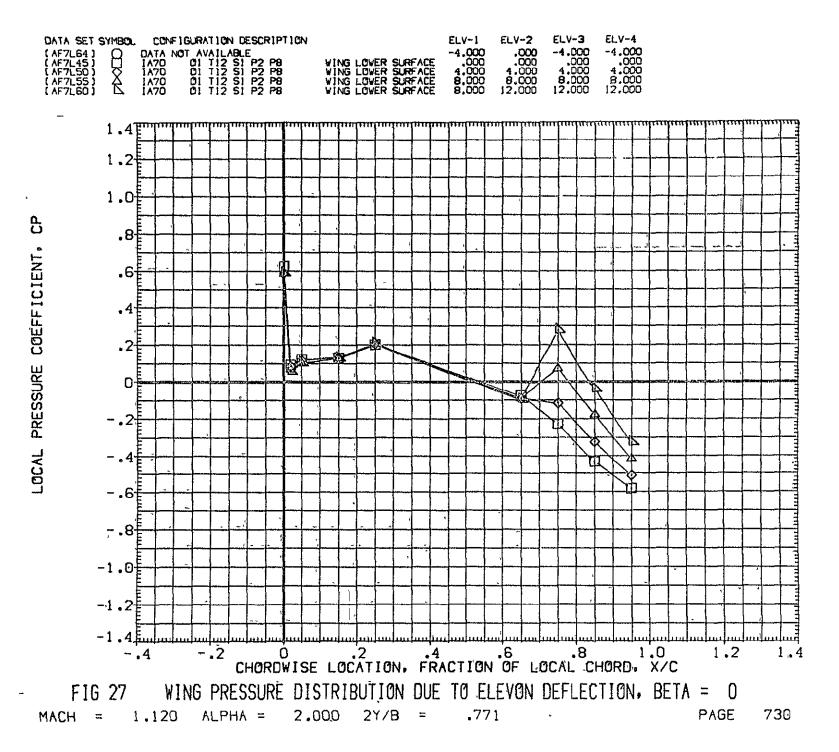


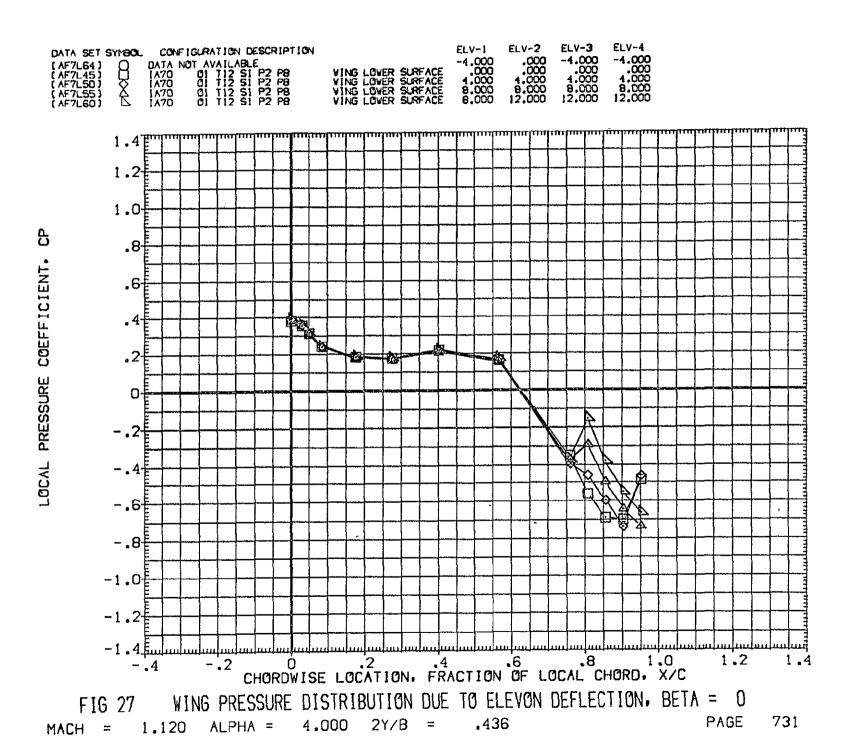


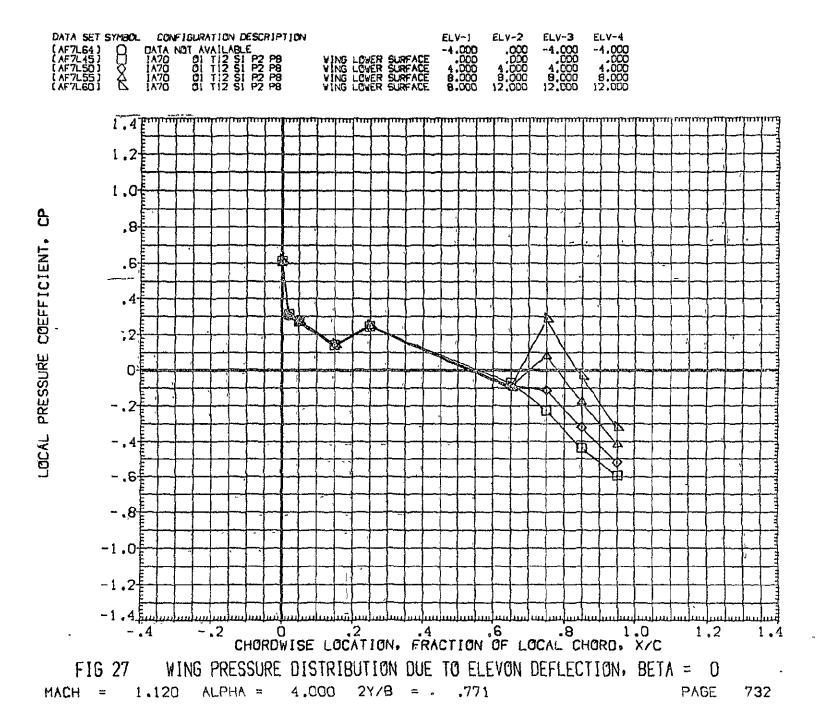


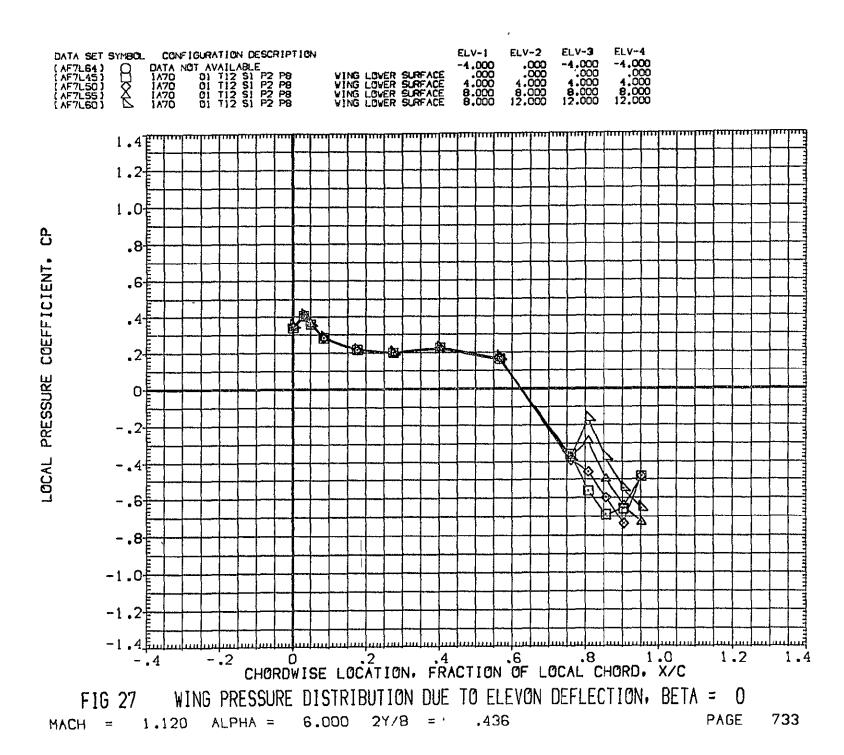


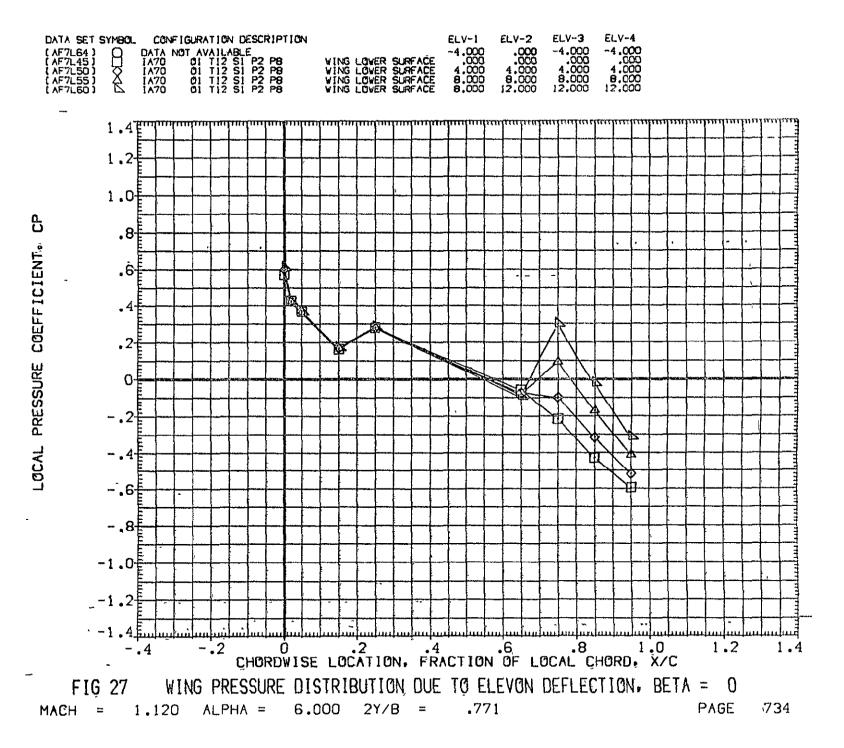


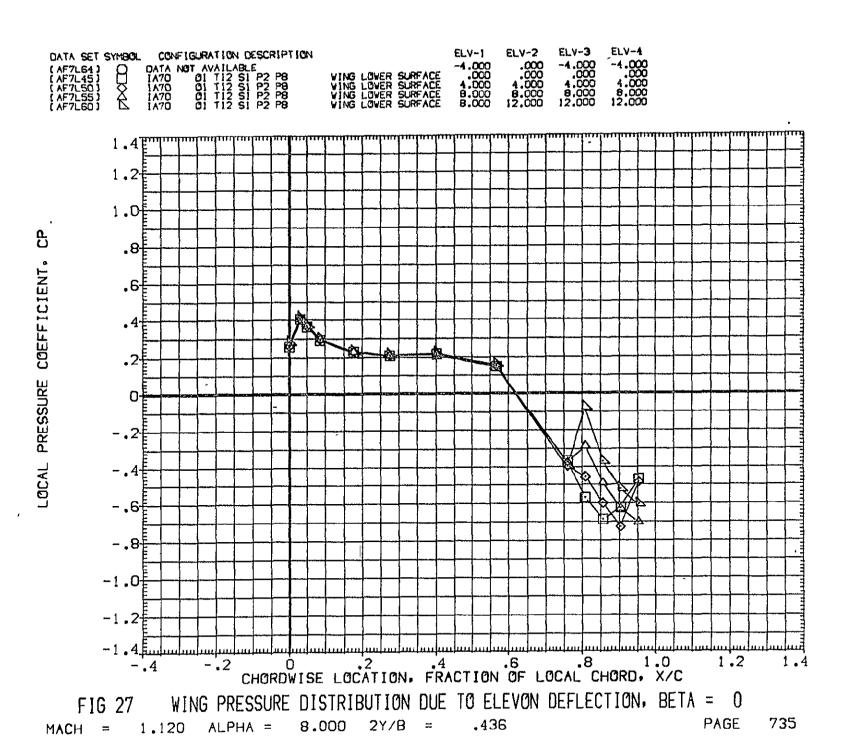


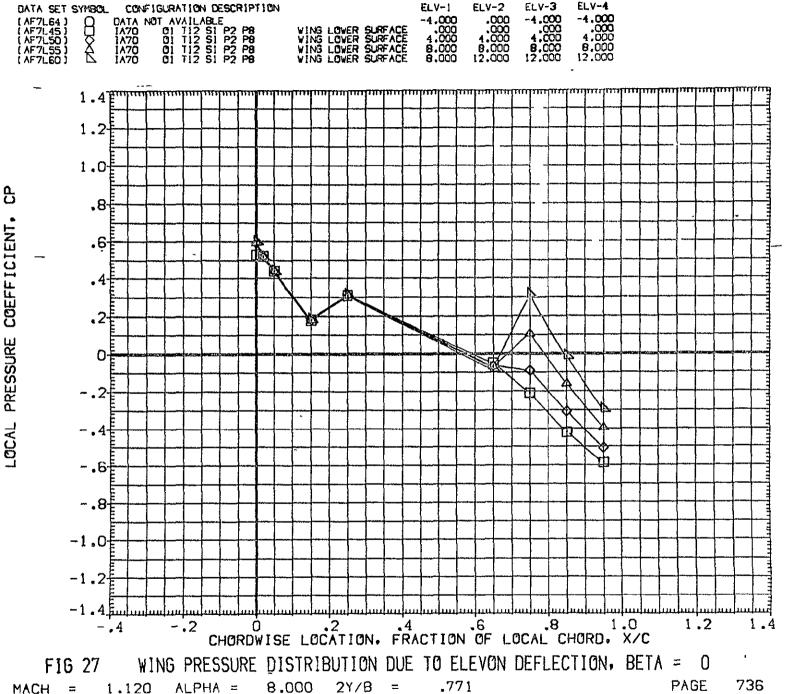




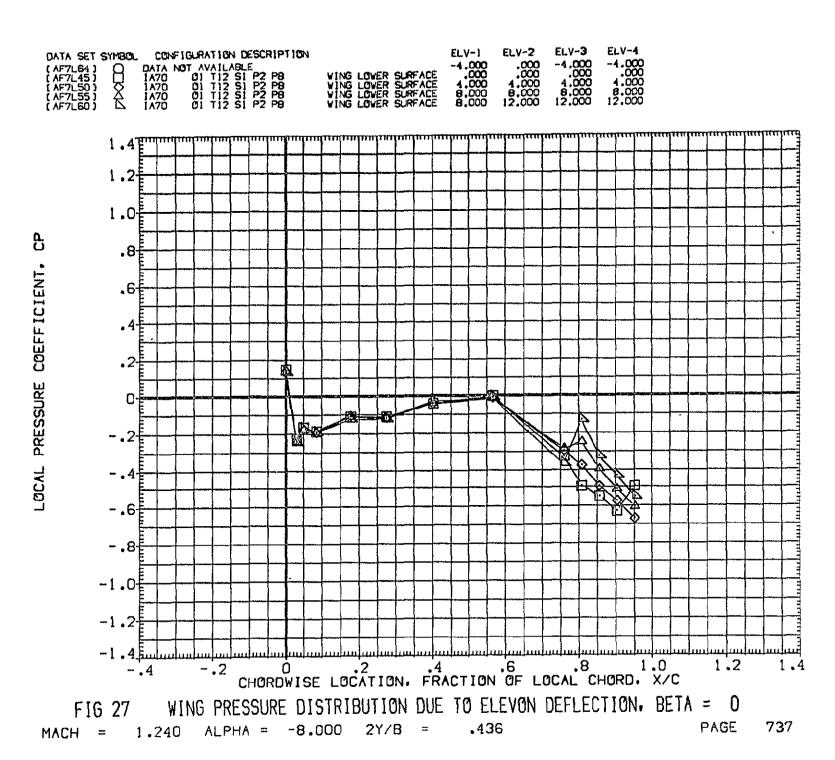


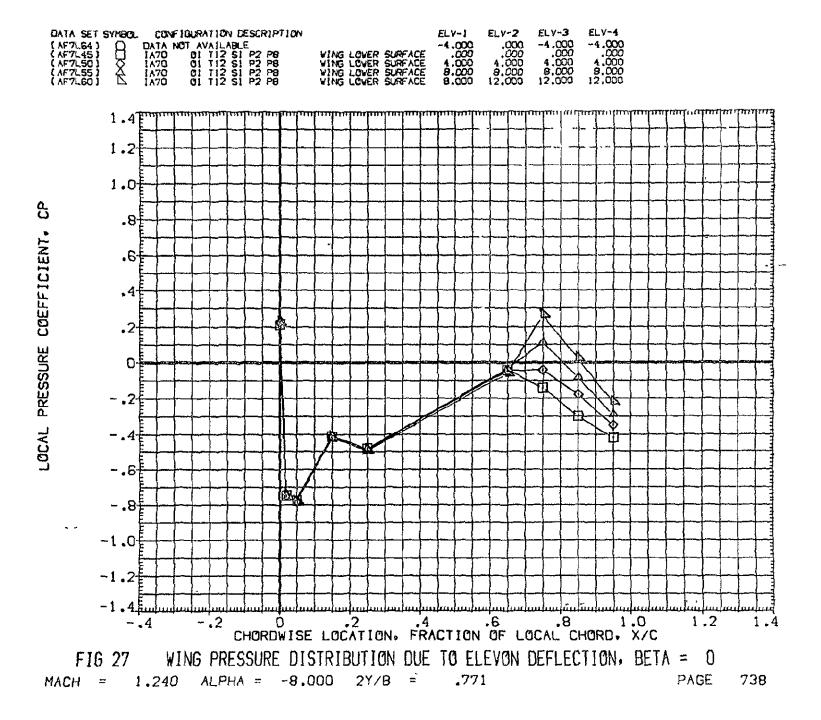


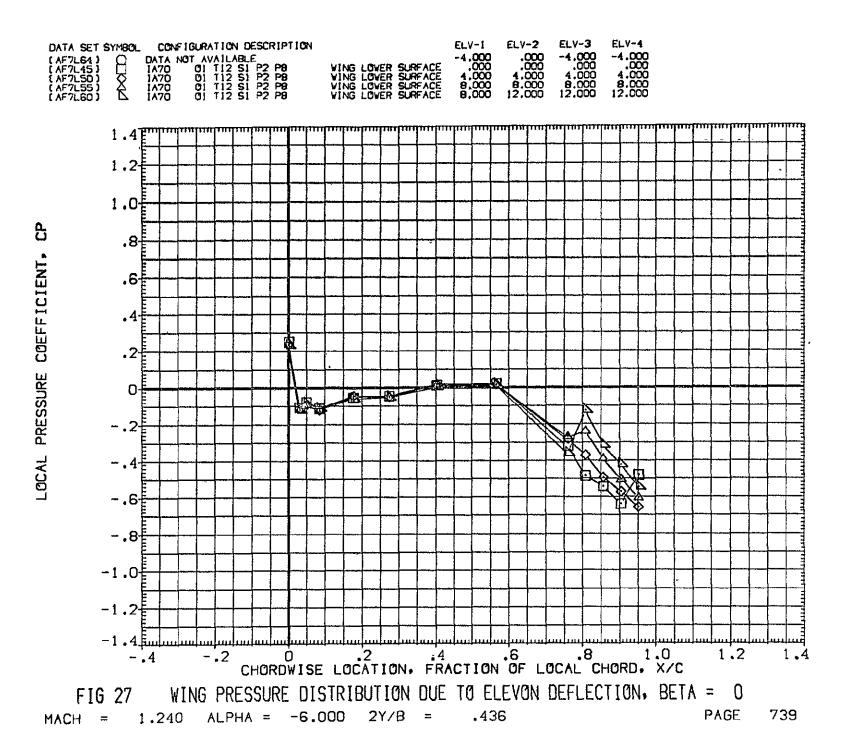


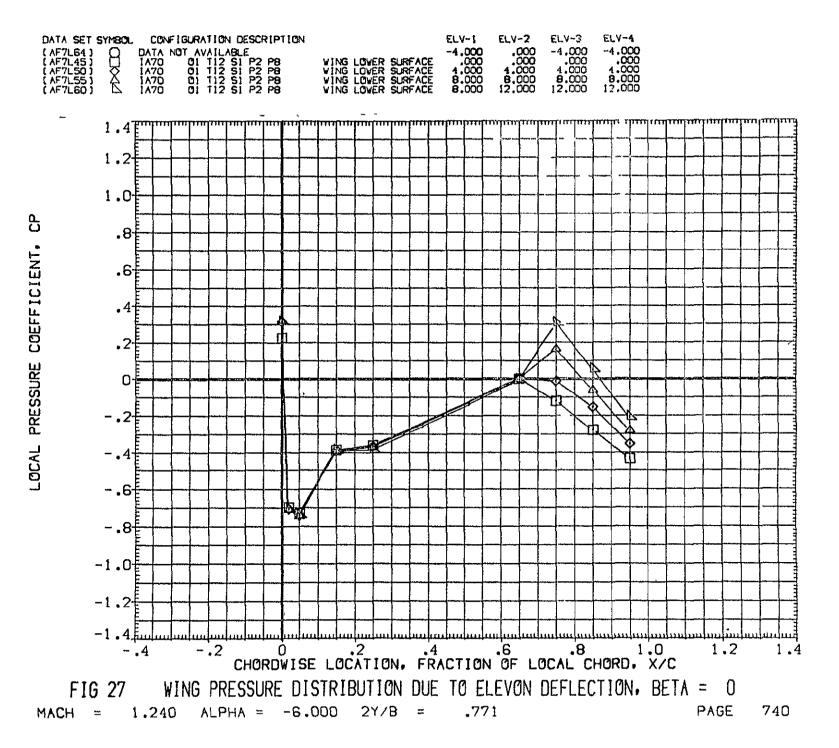


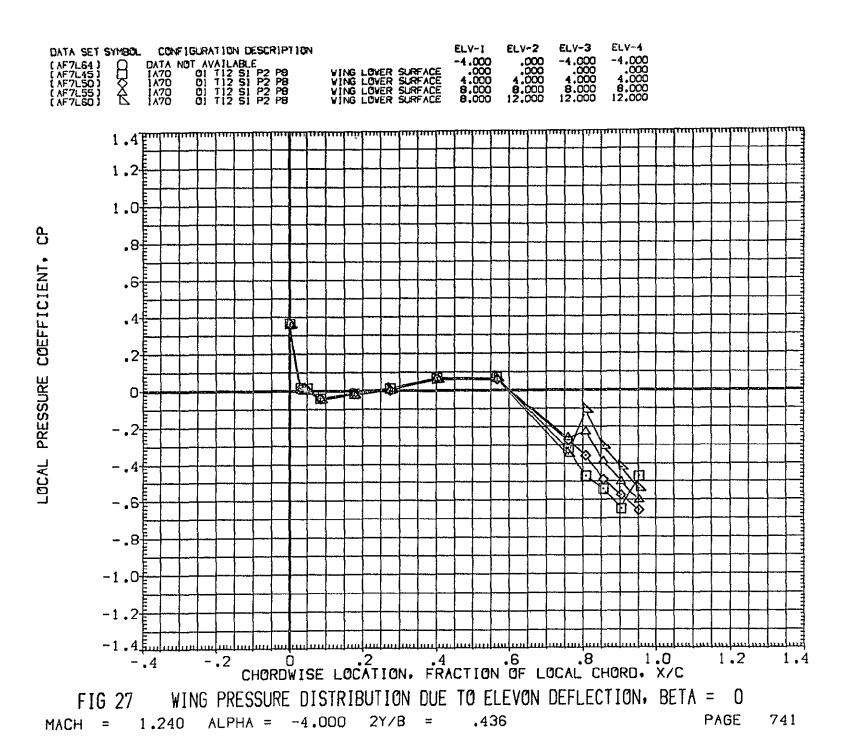
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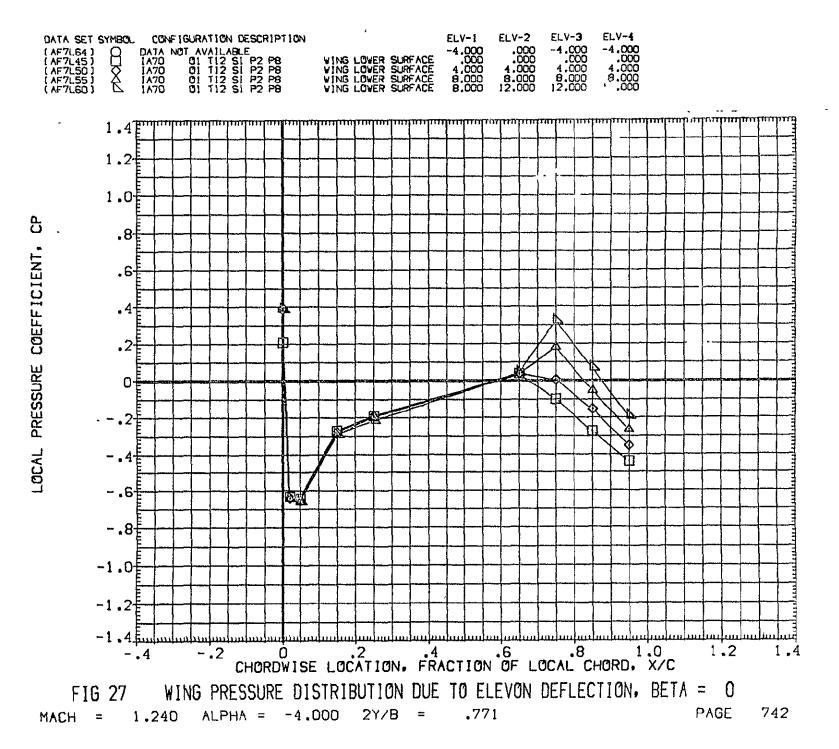


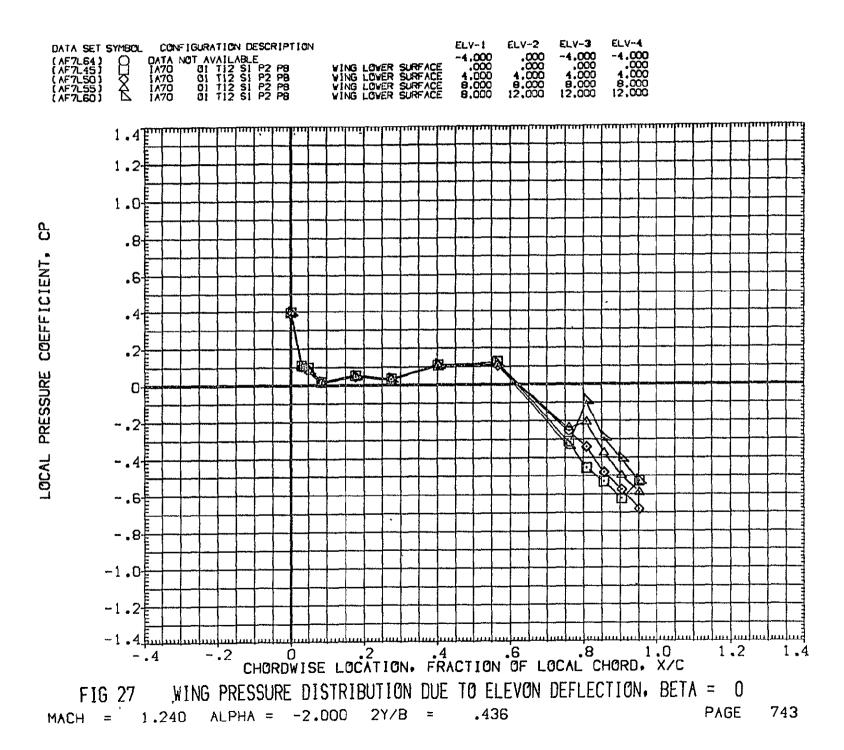


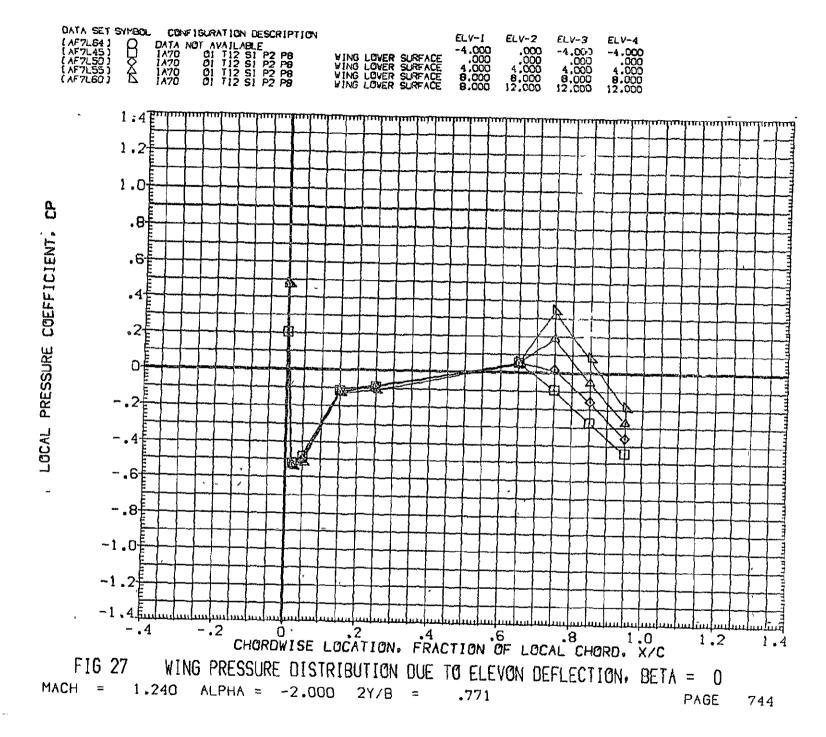


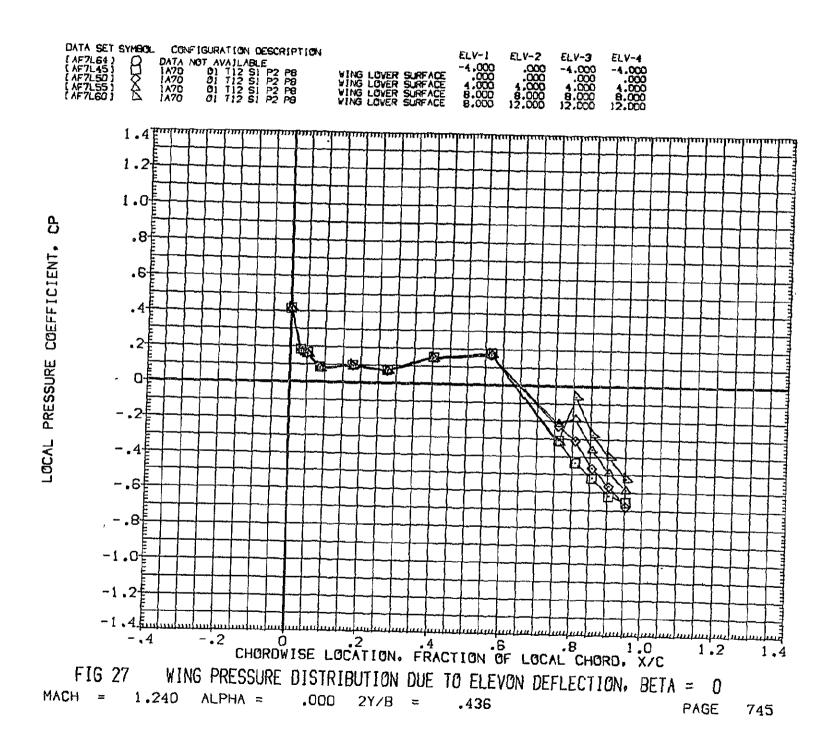


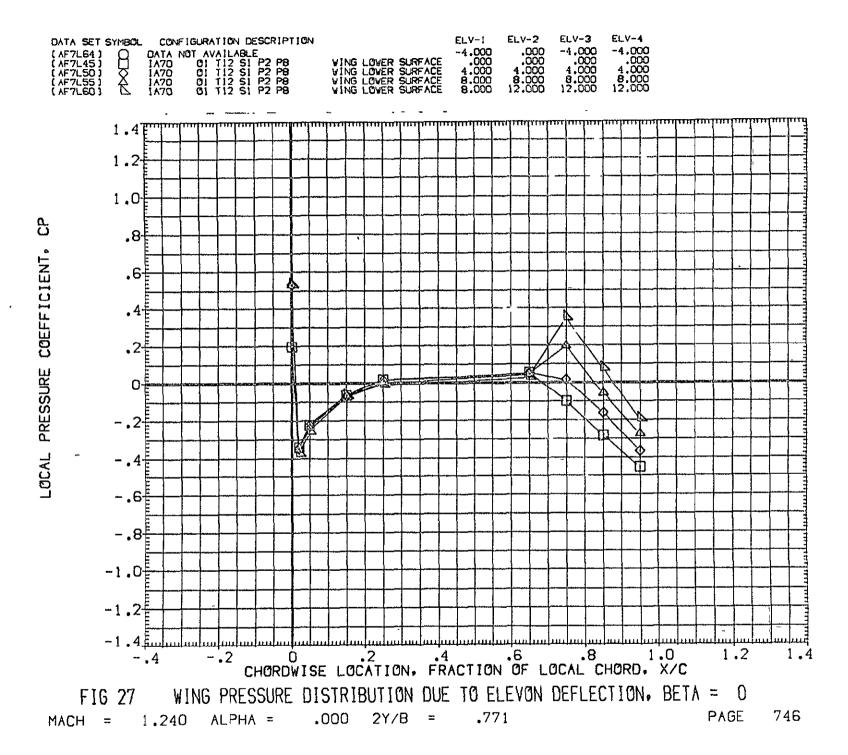


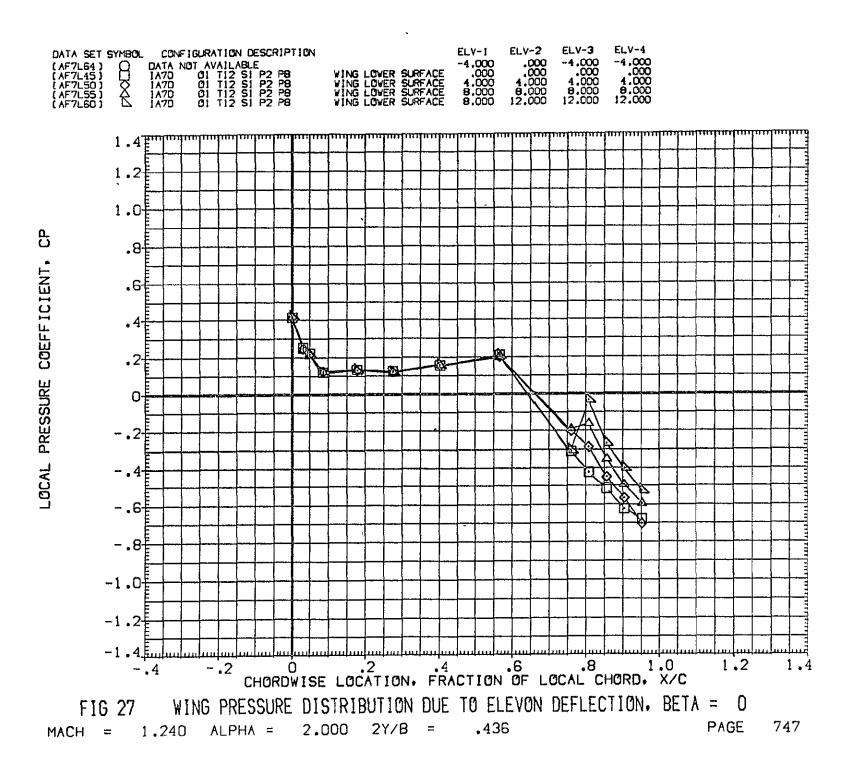


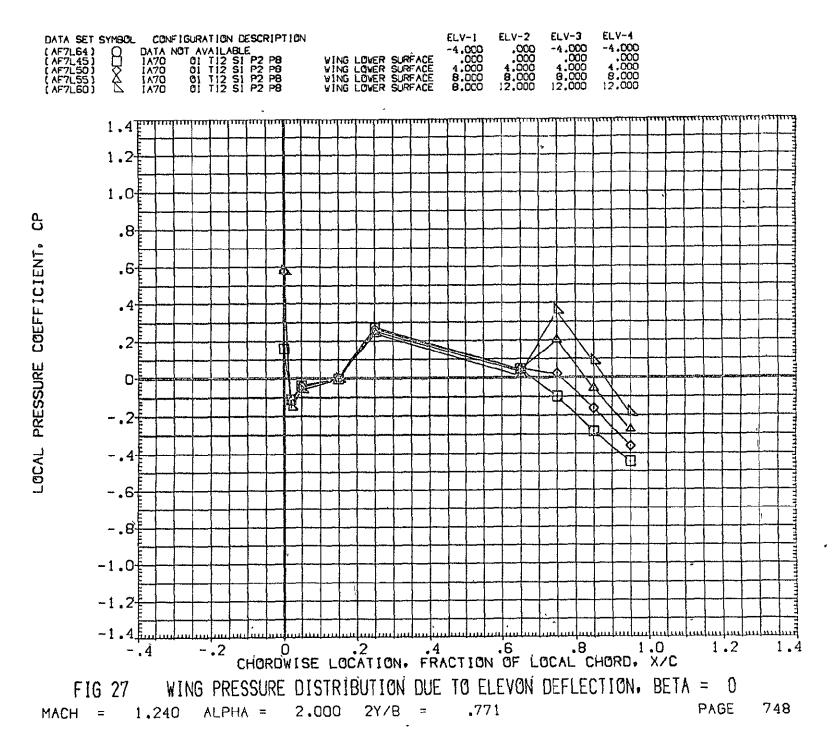


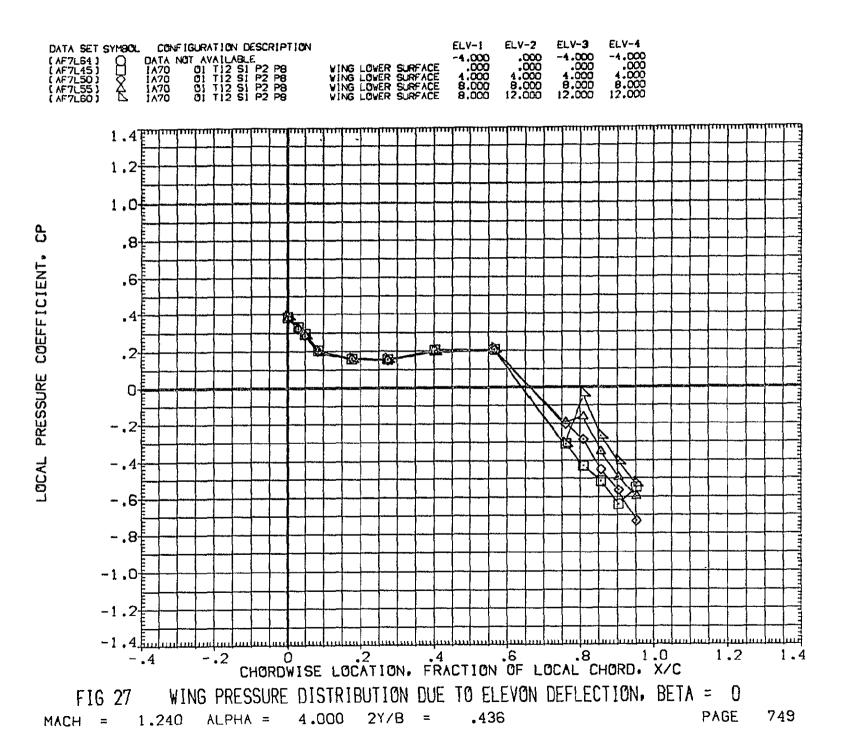


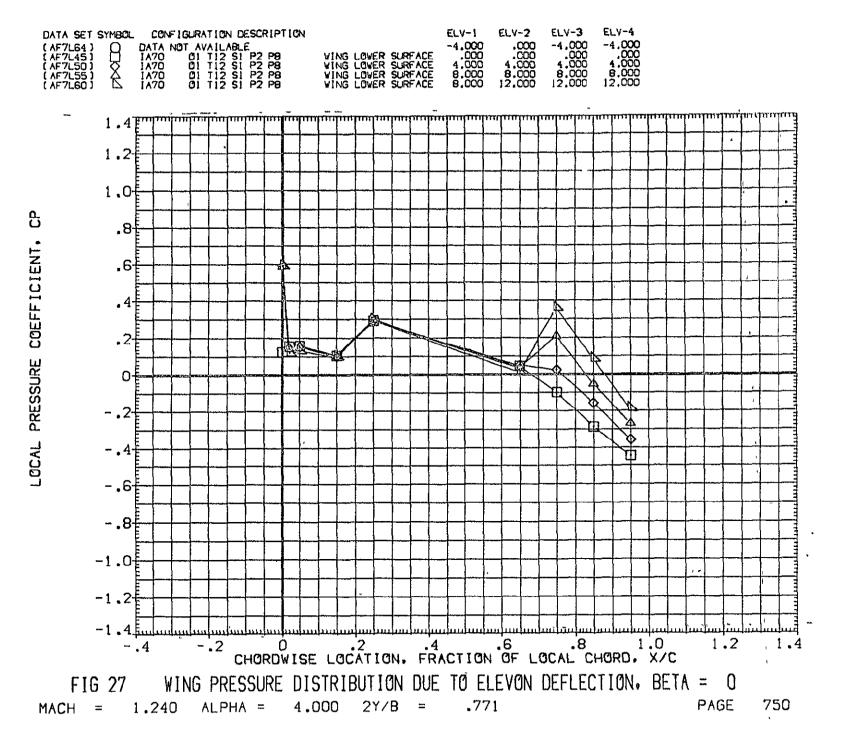




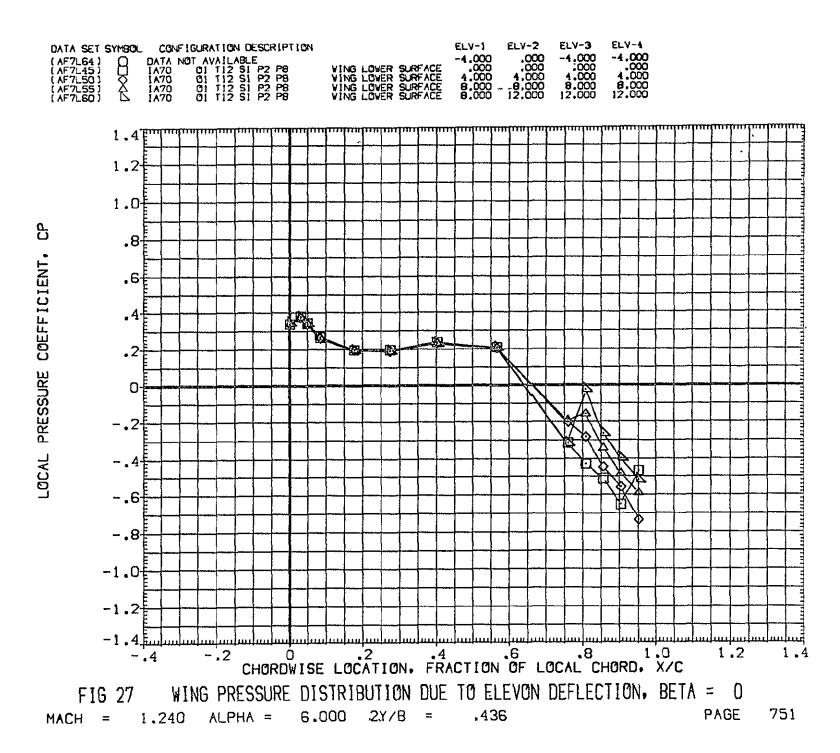


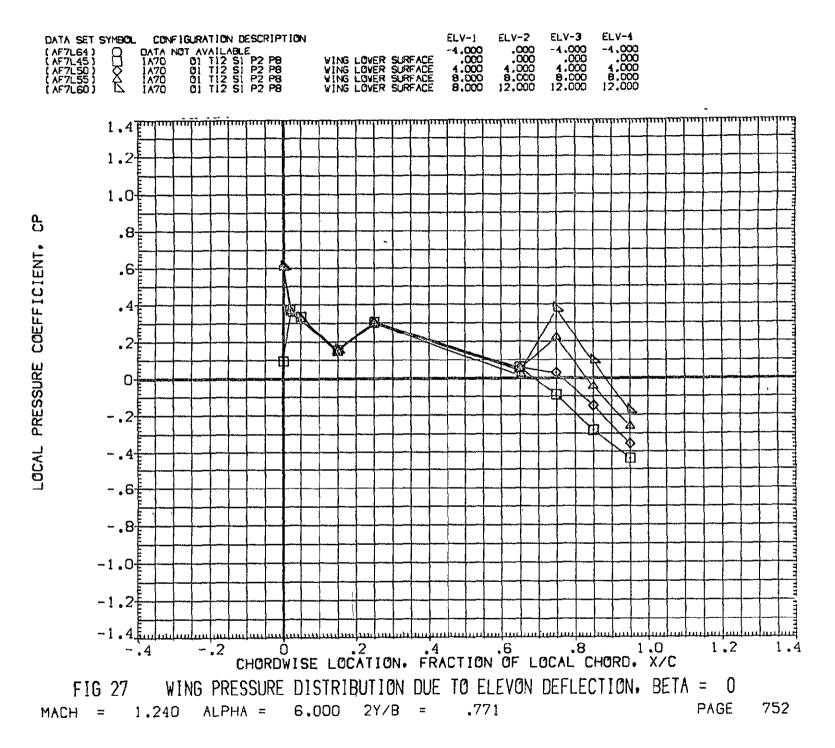


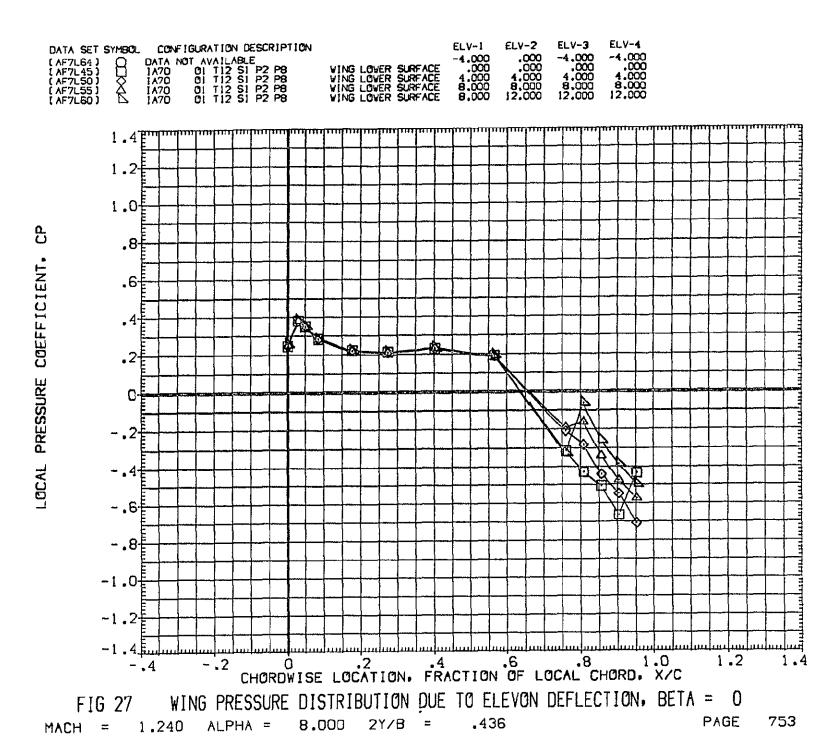


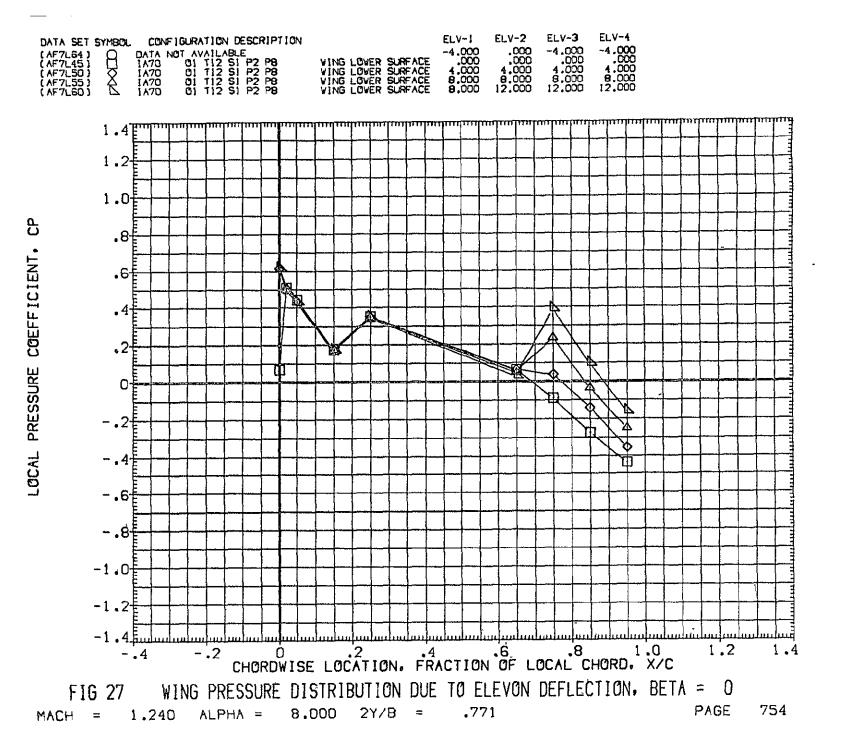


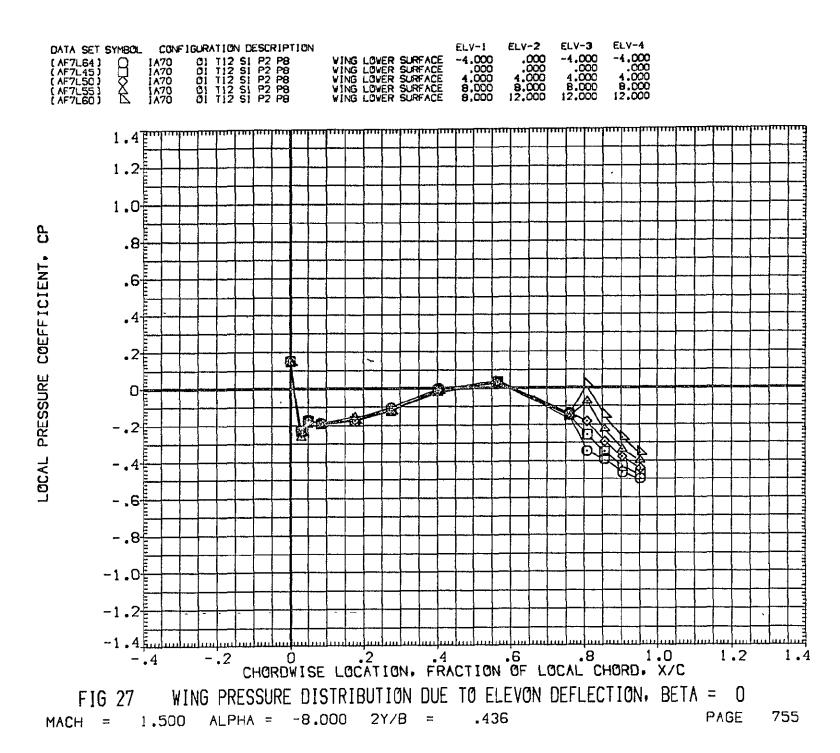
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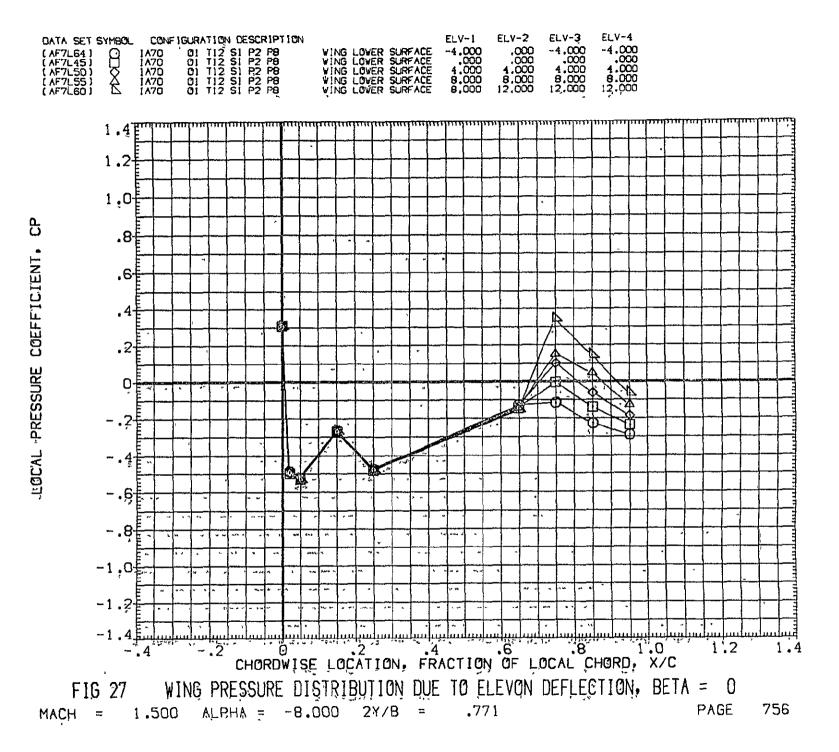


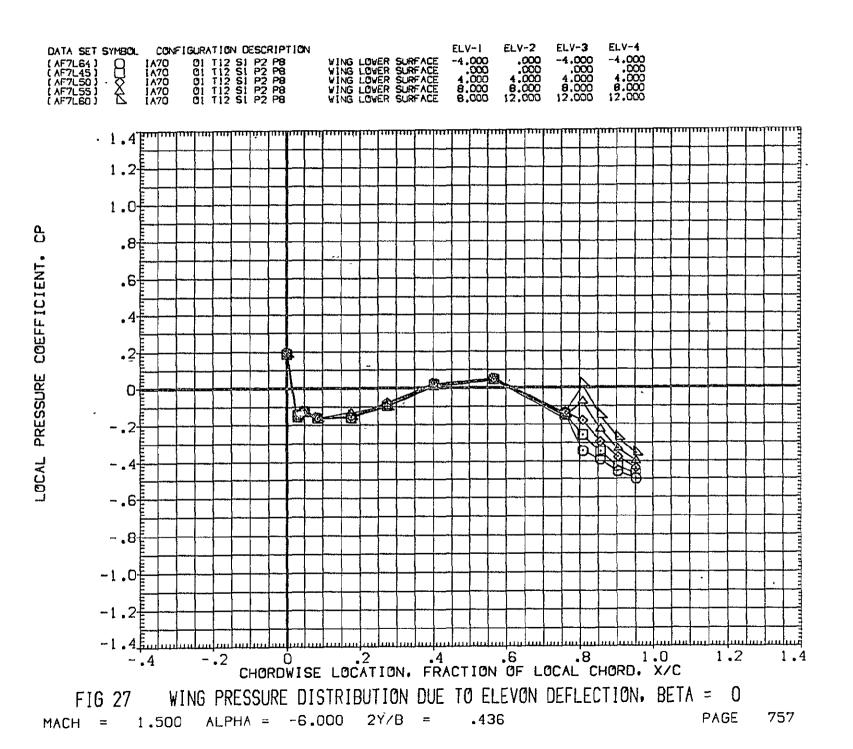


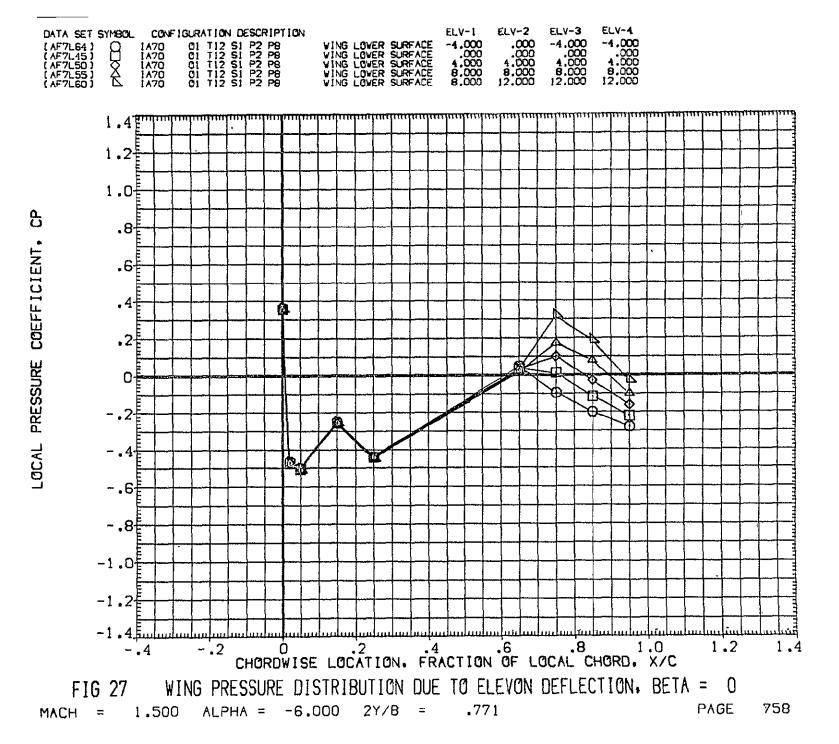


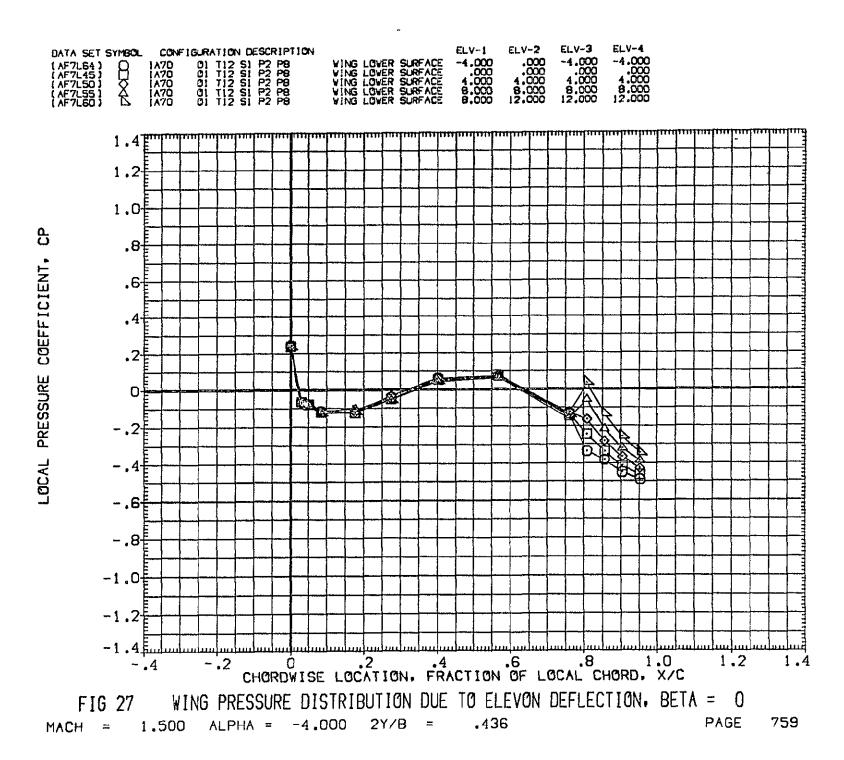


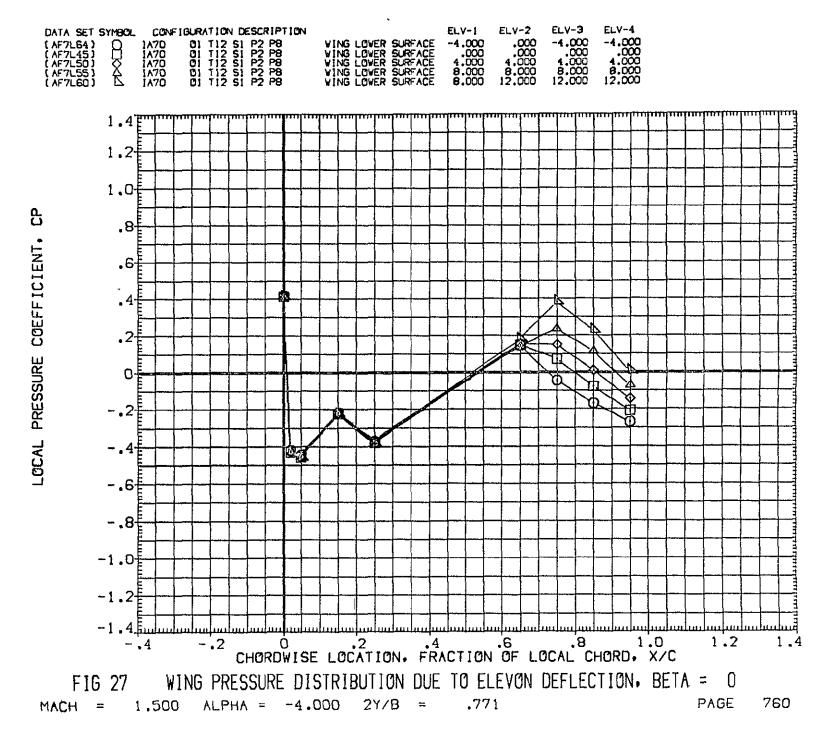


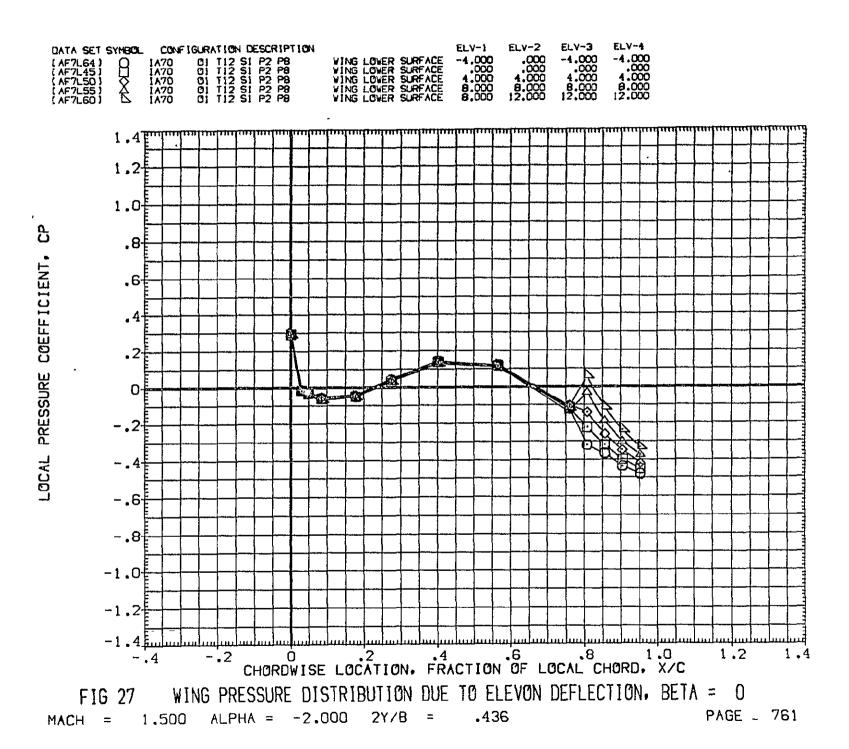


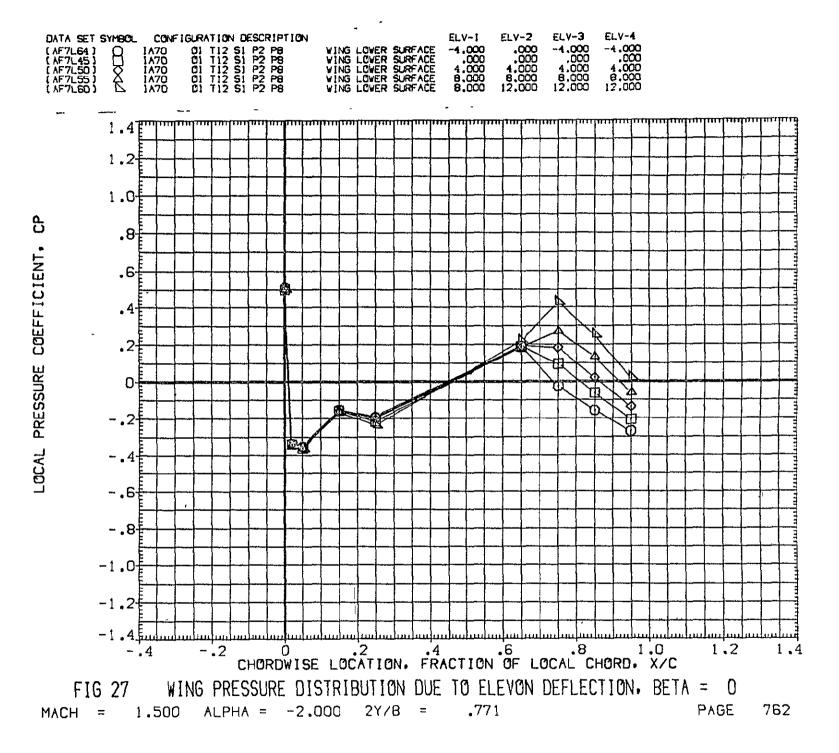


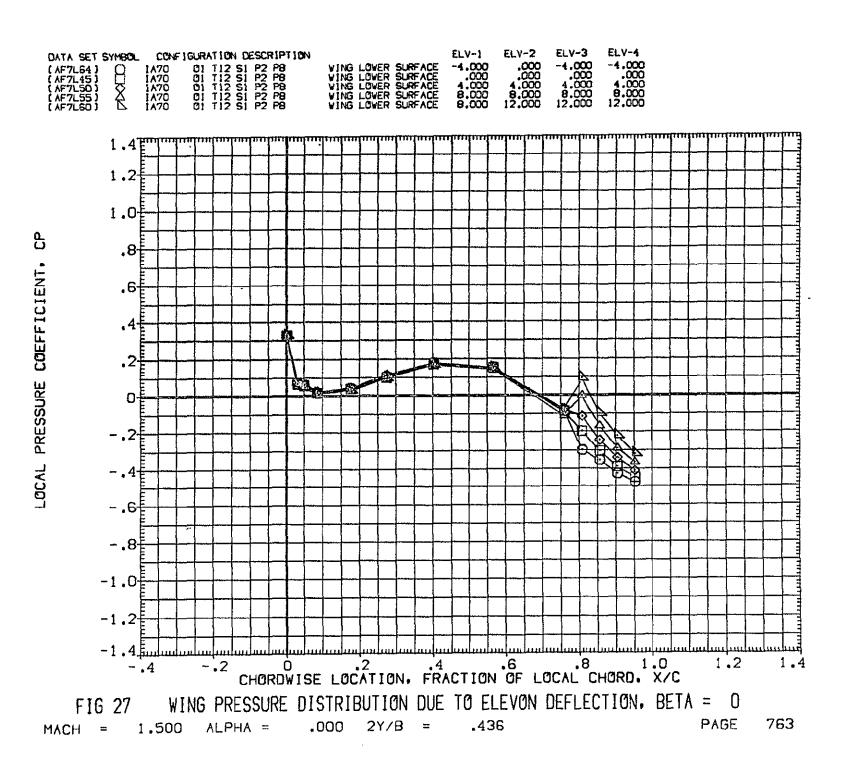


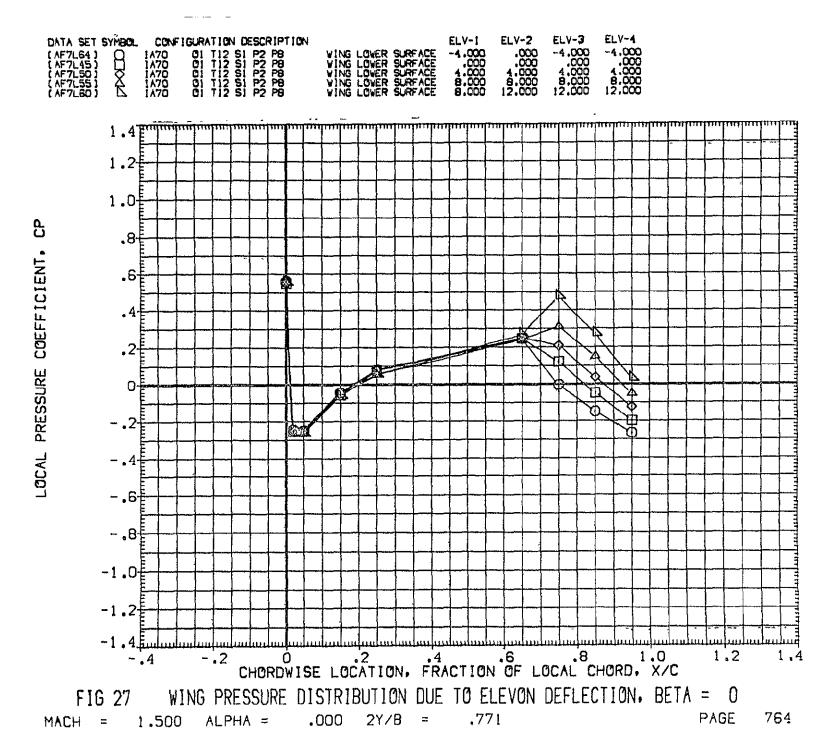


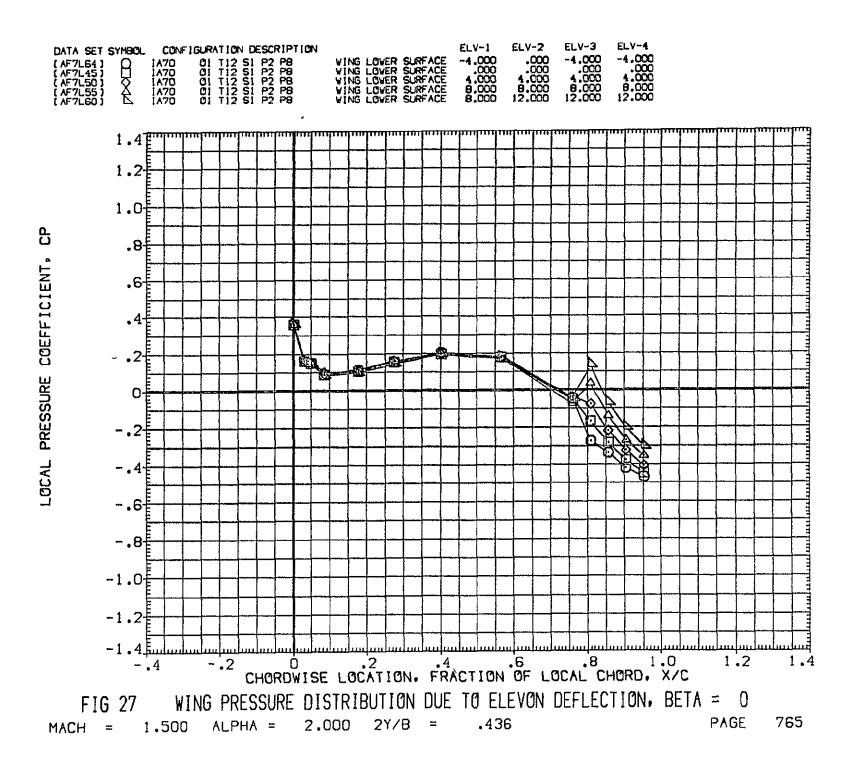


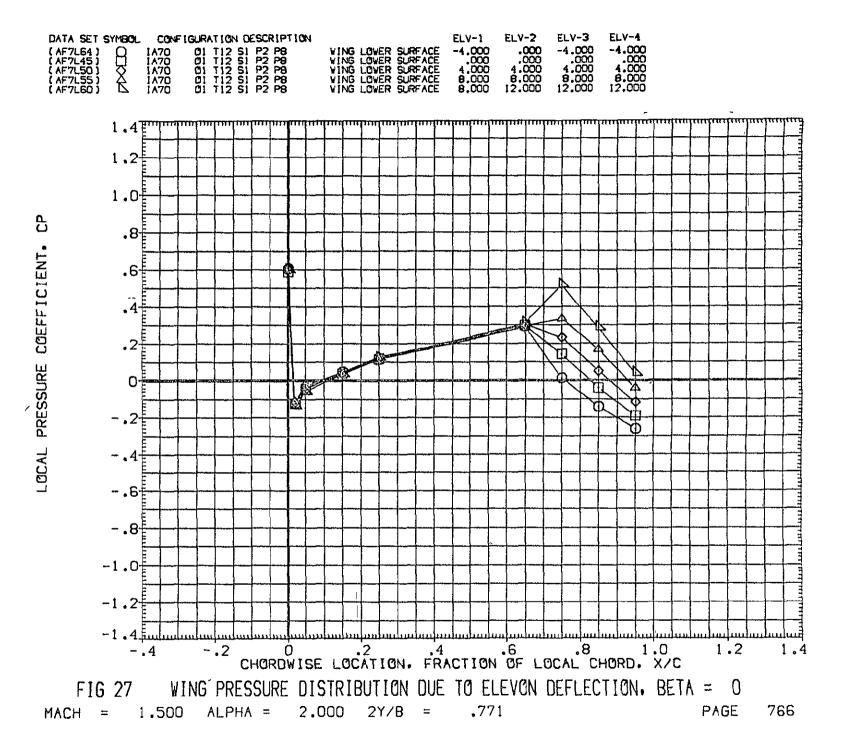


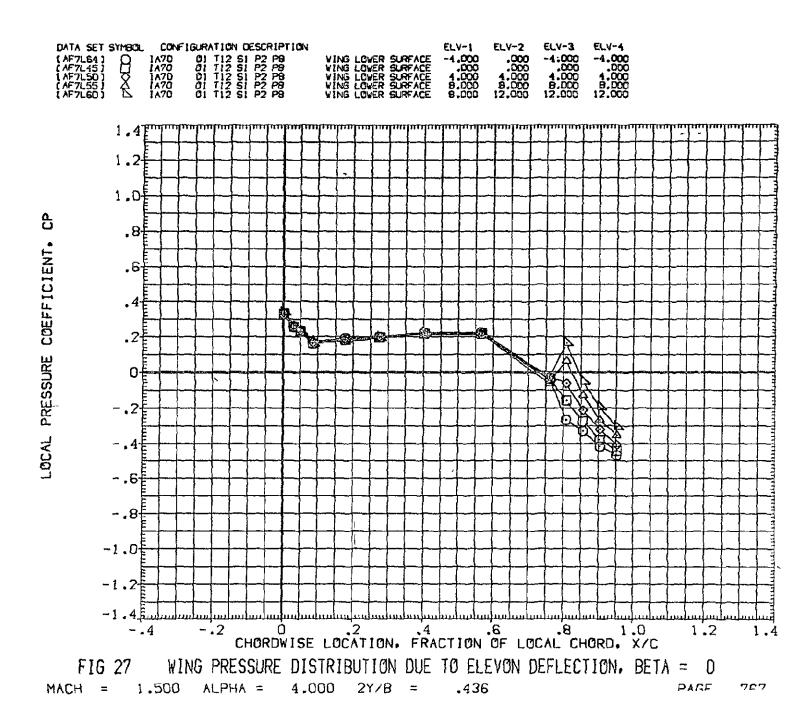


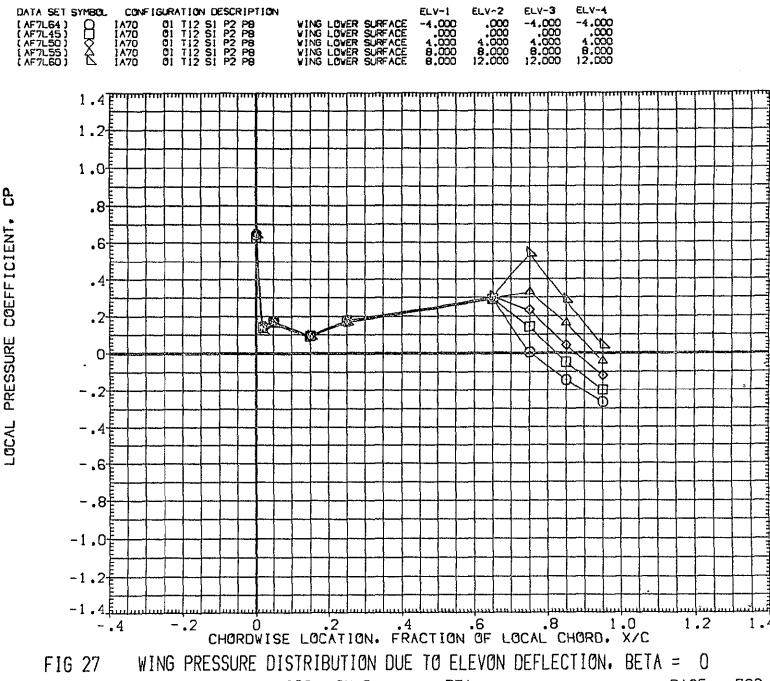




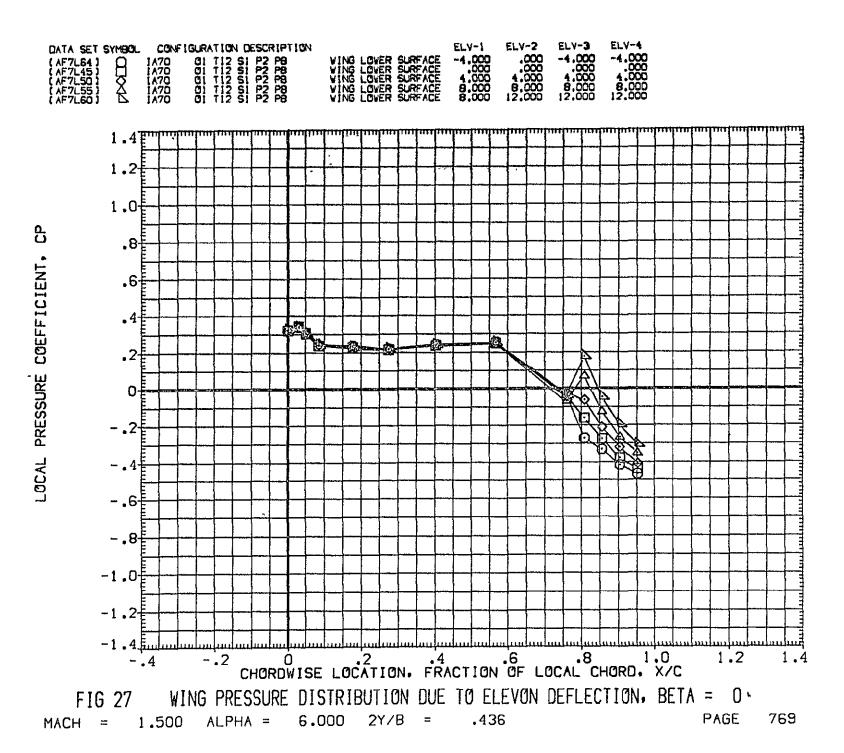


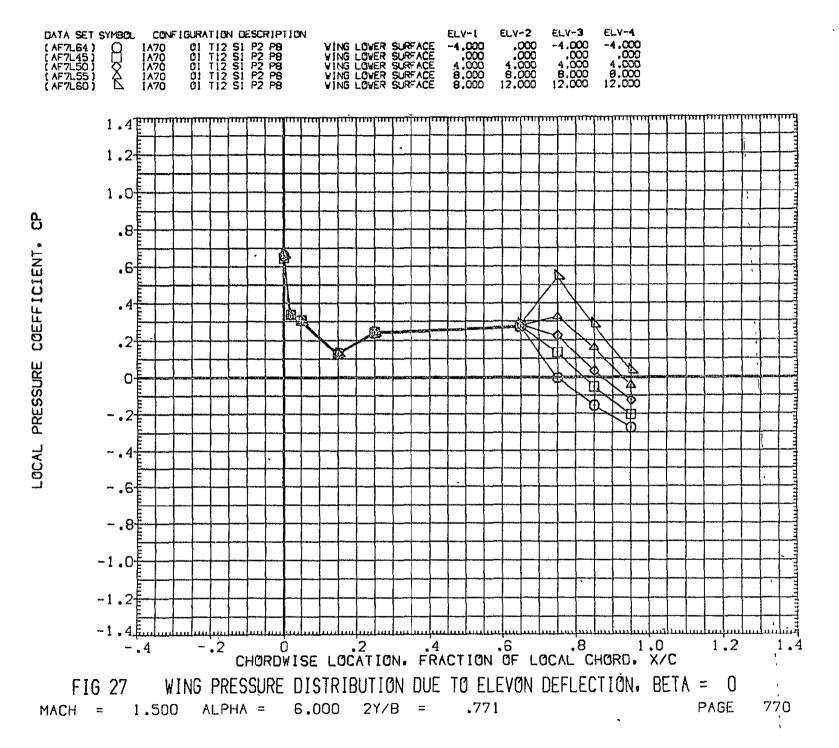


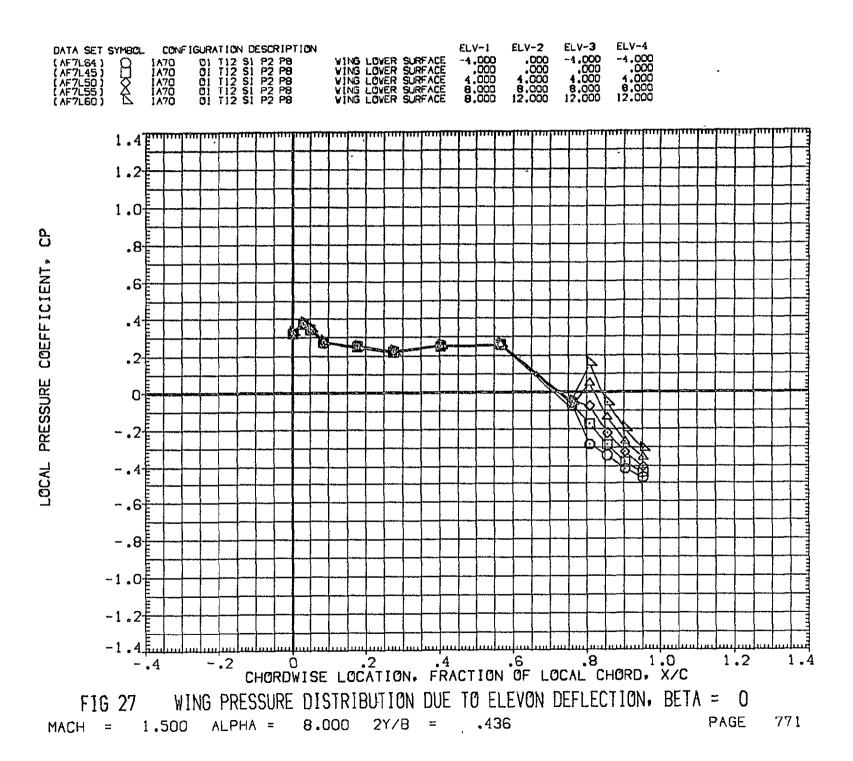


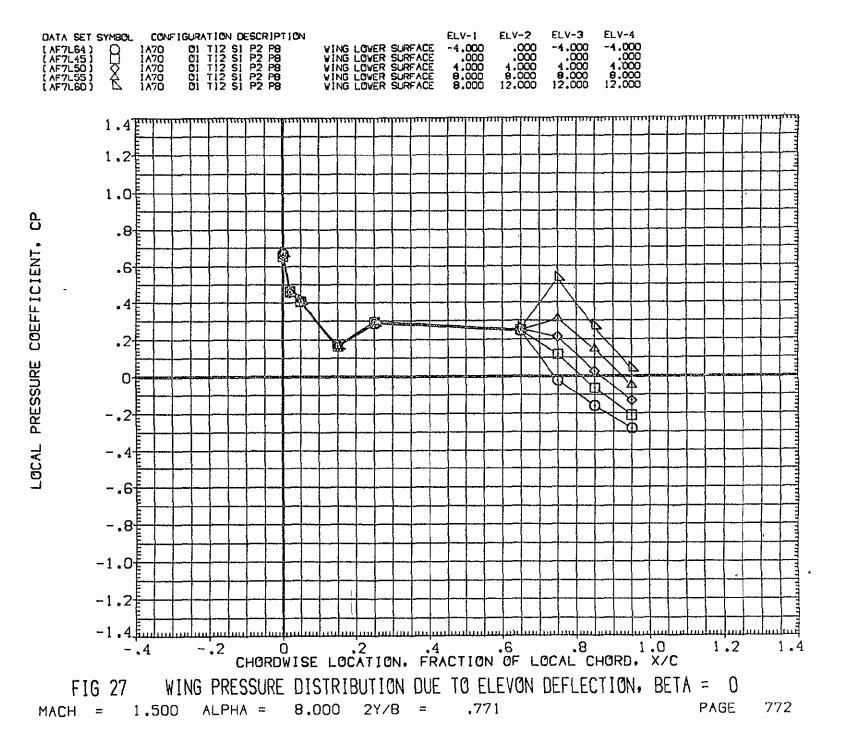


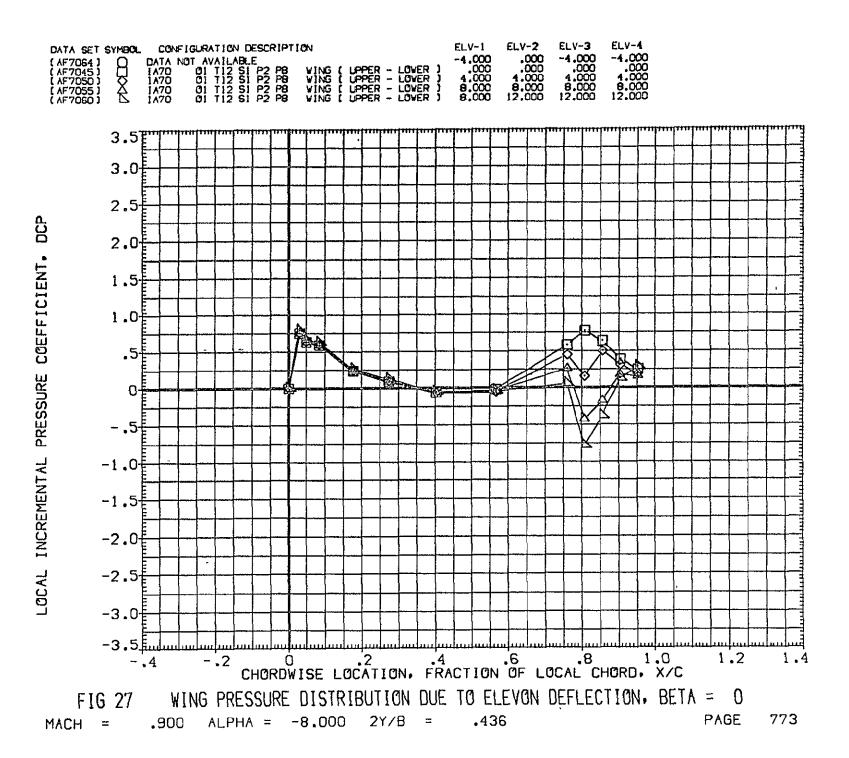
.771 PAGE 768 1.500 ALPHA = 4.000 2Y/B = MACH =

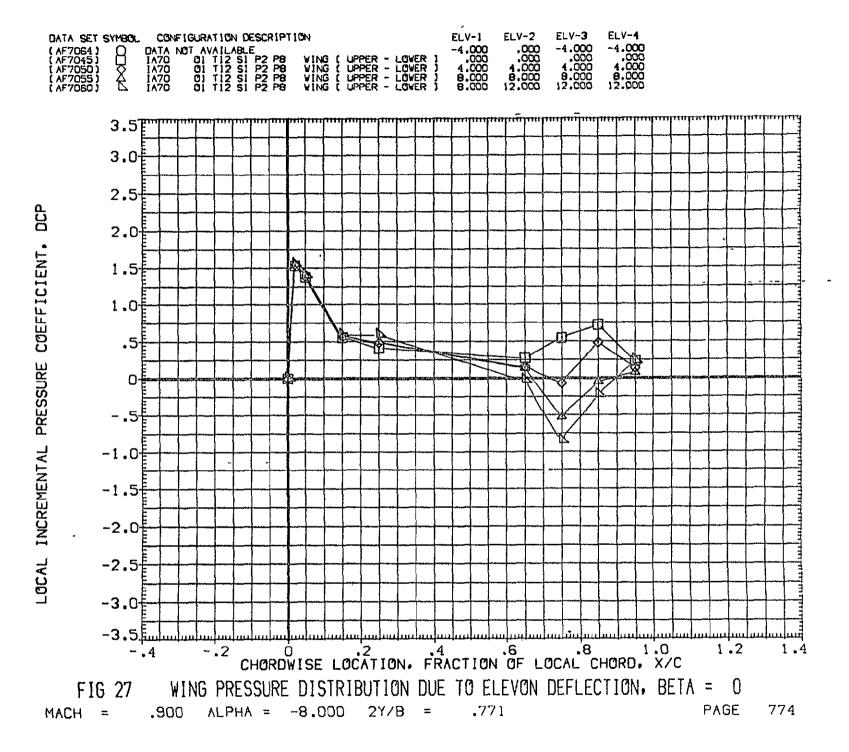


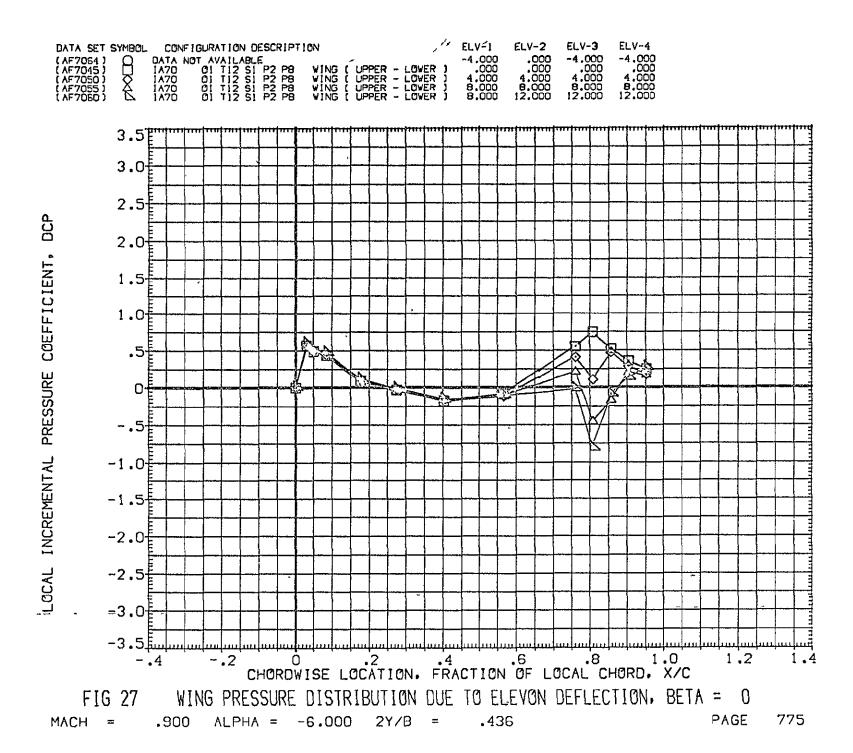


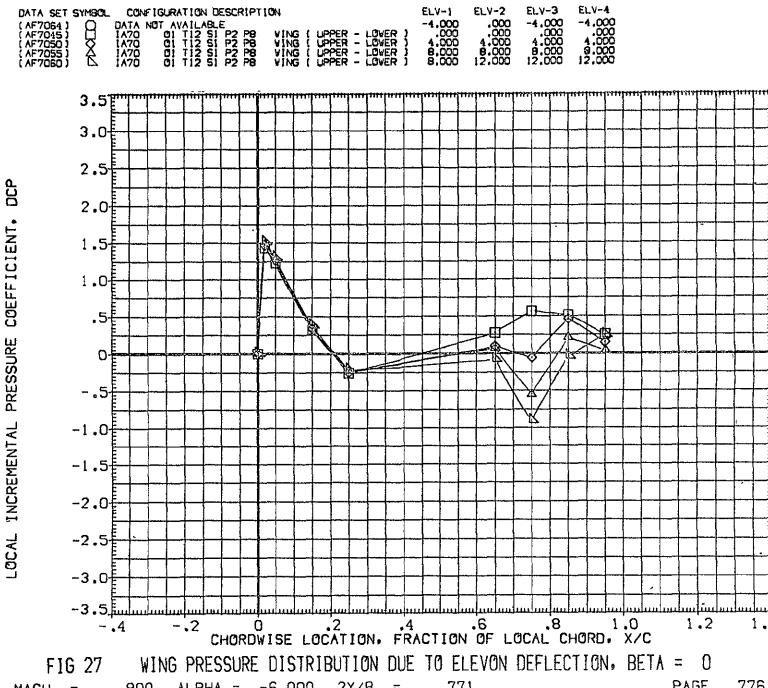




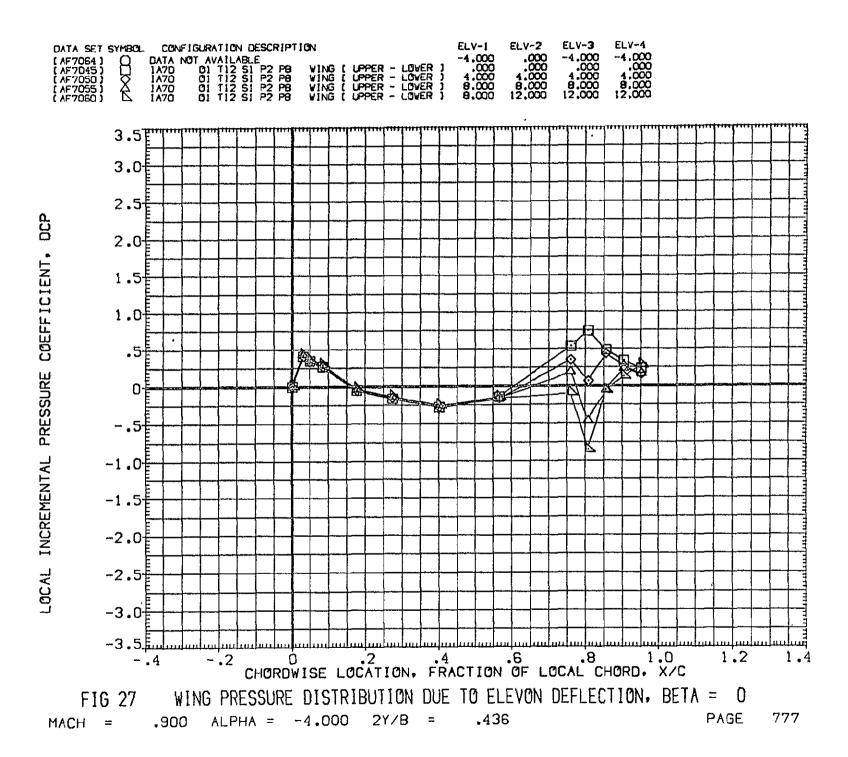


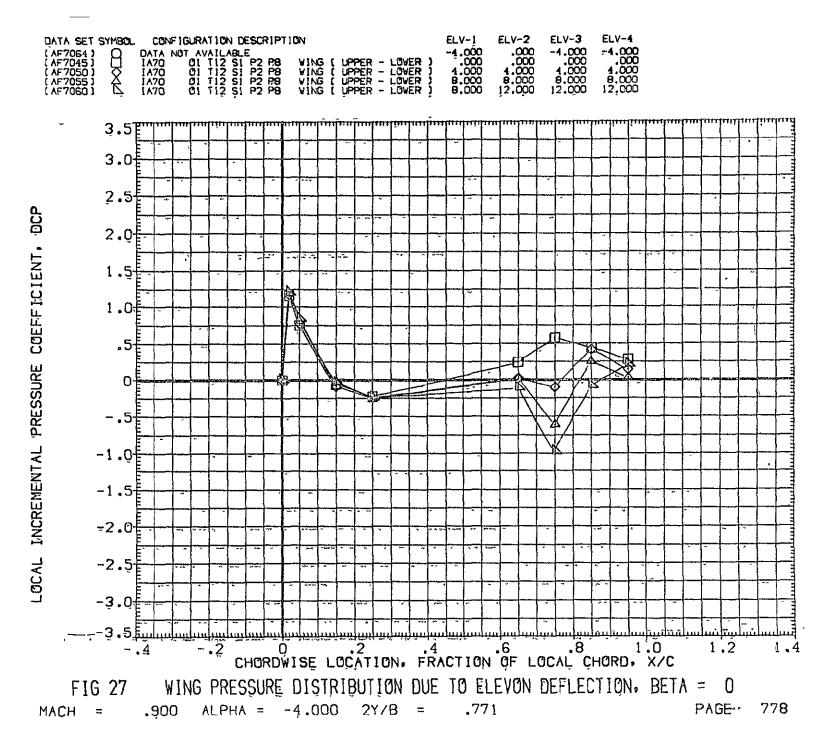


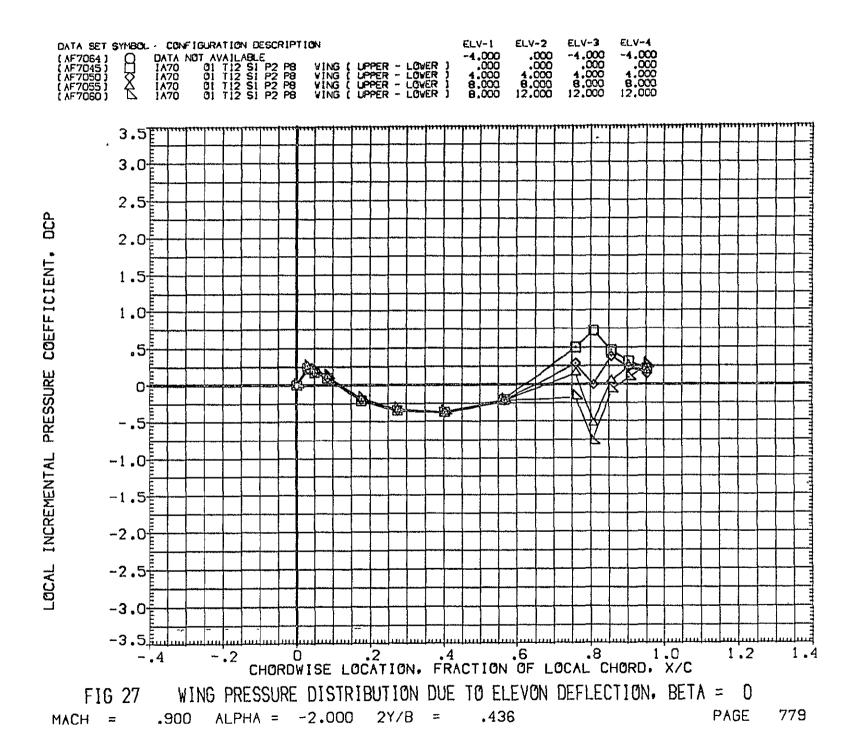


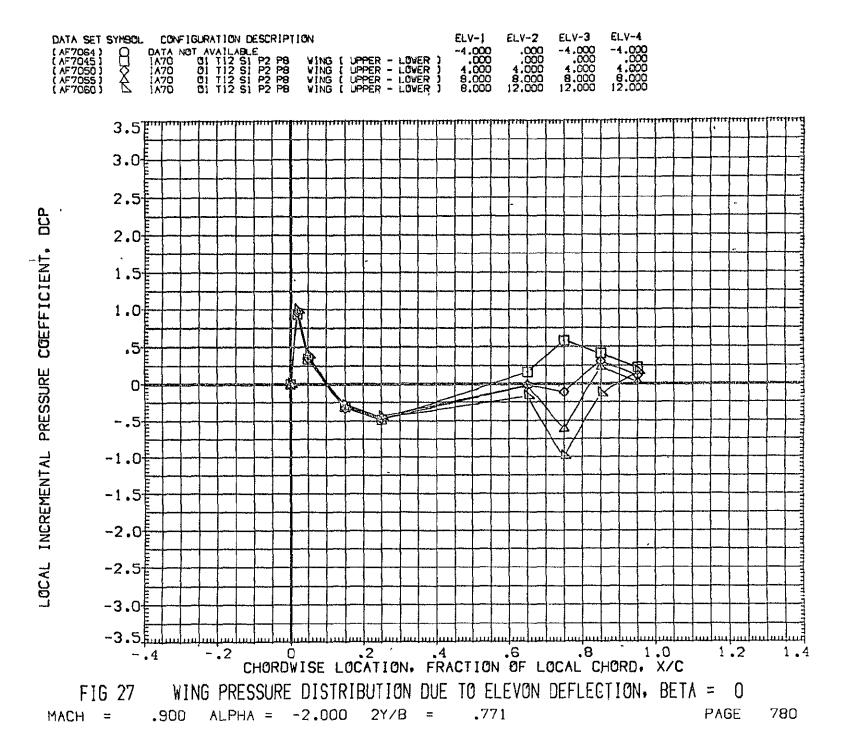


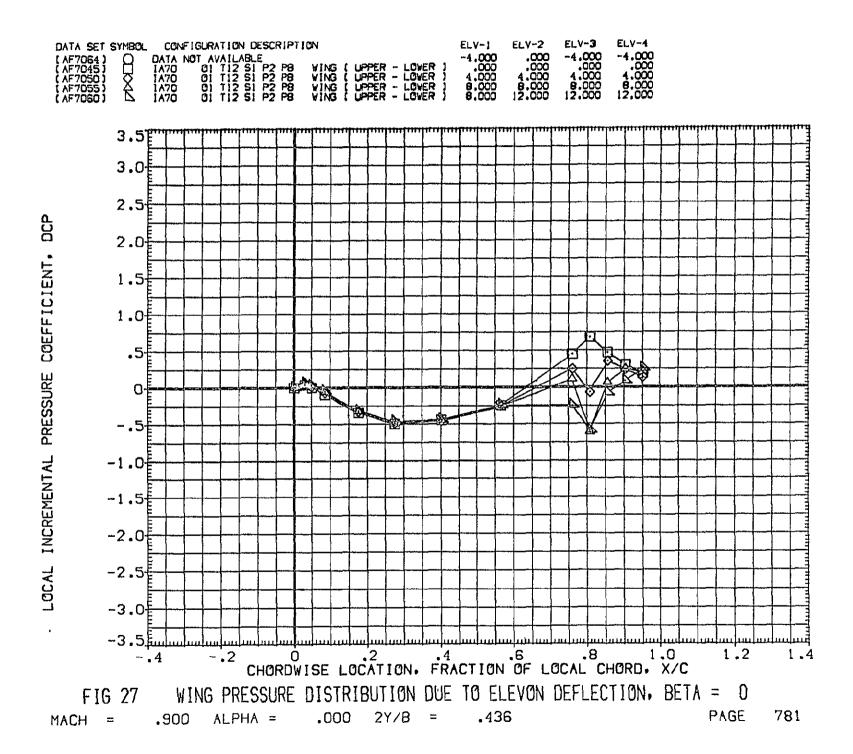
PAGE 776 ALPHA = -6.000 2Y/B =.771 MACH = .900

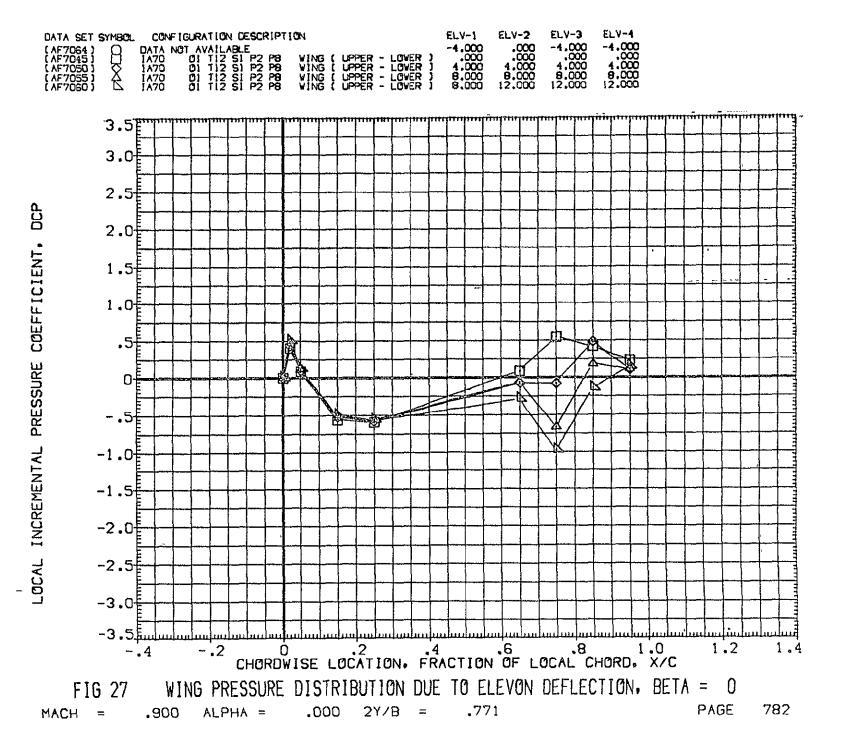


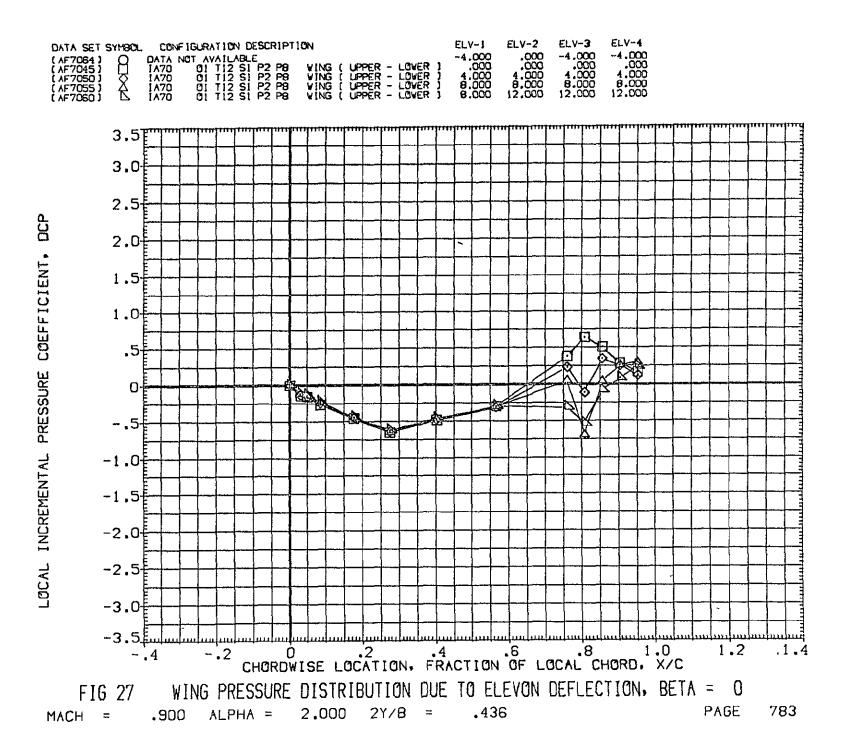


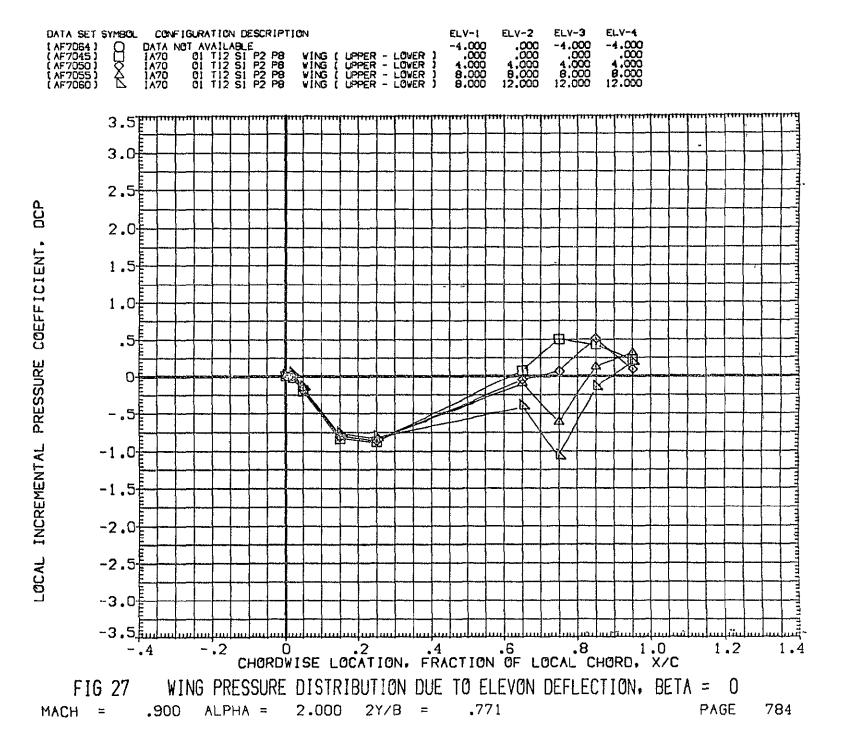


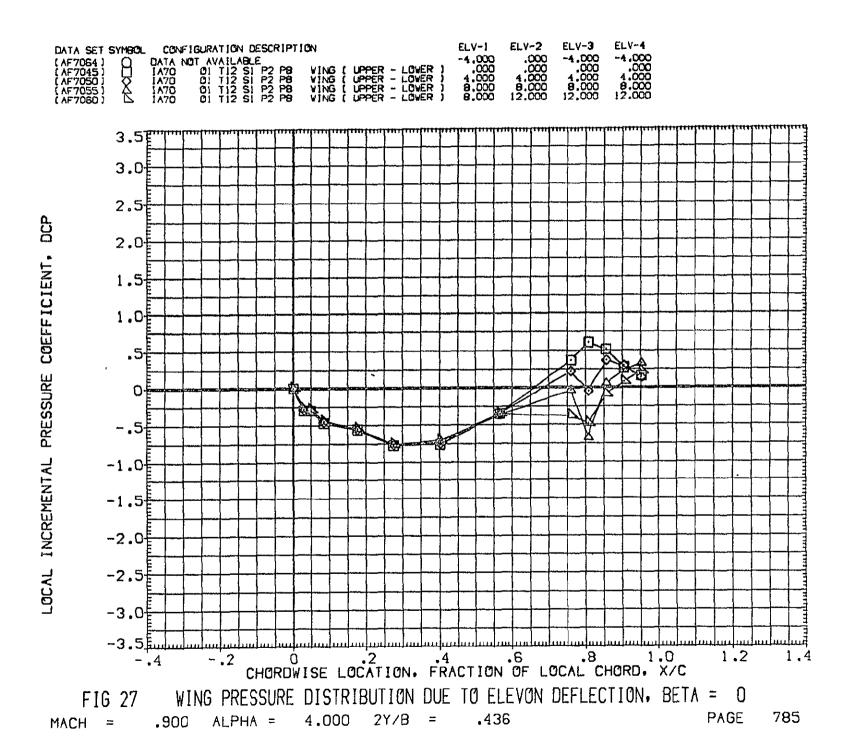


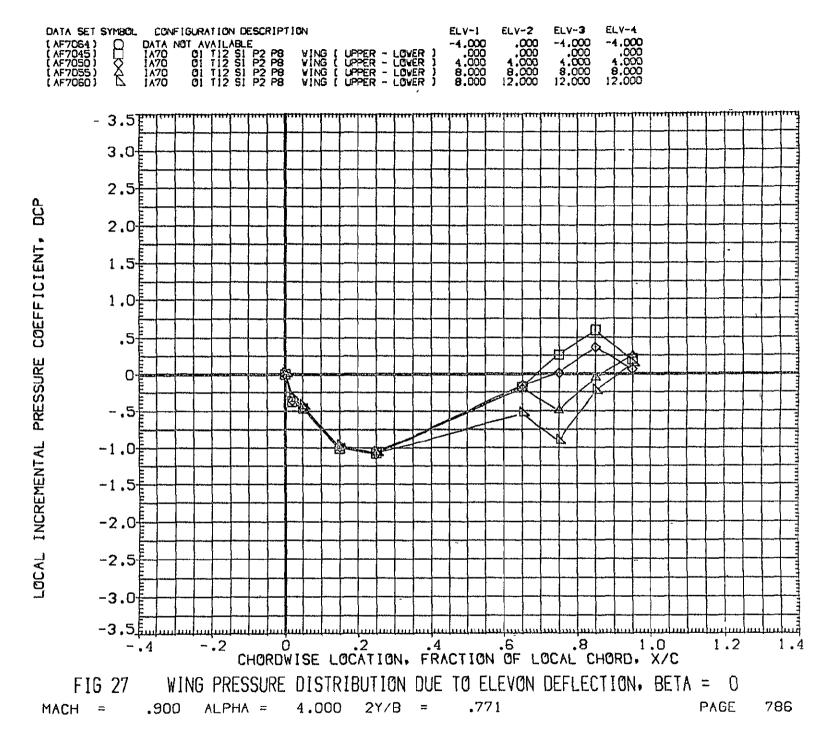


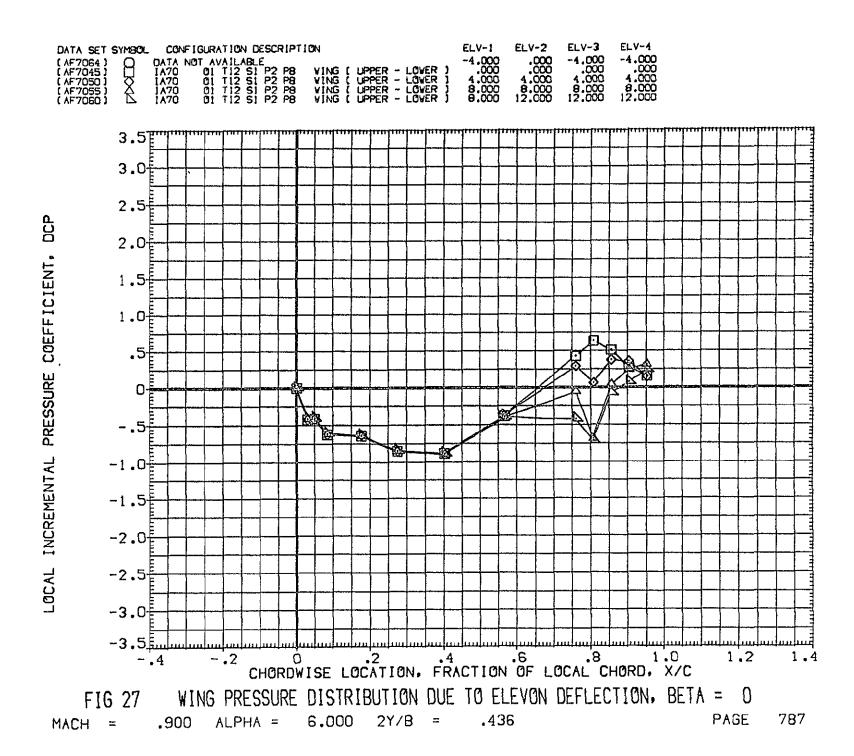


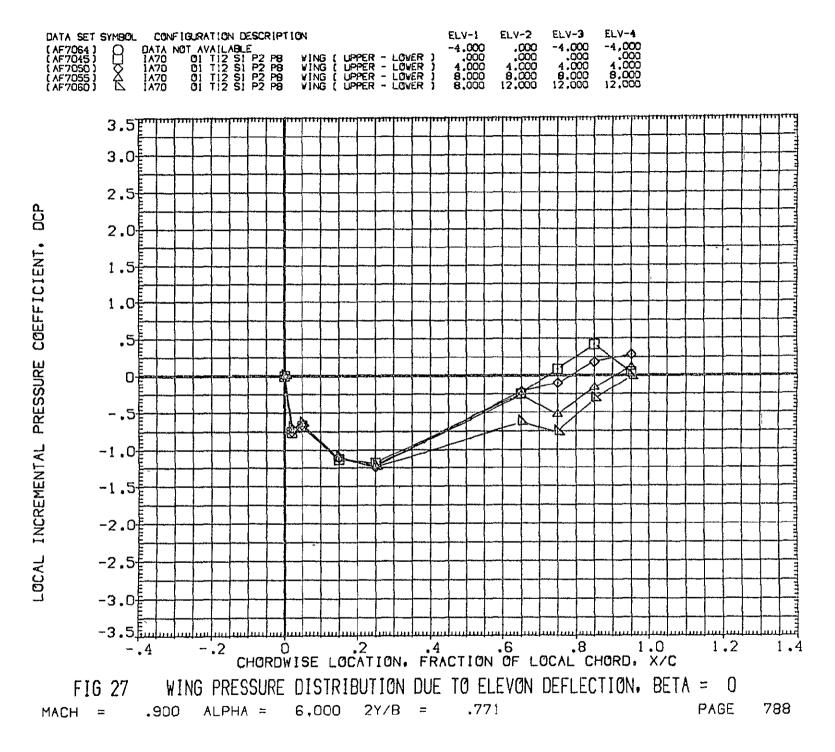


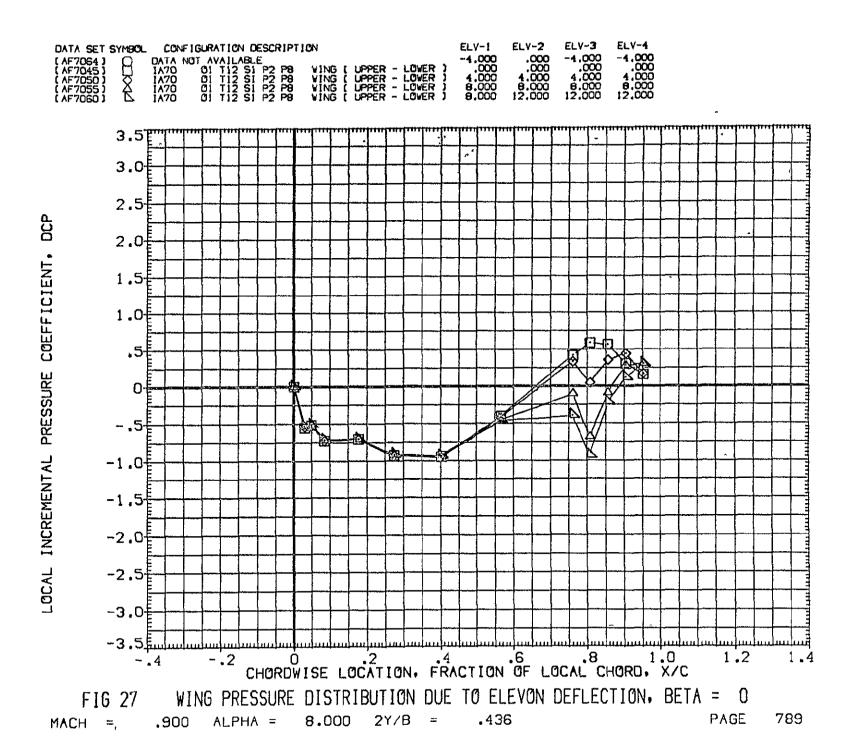


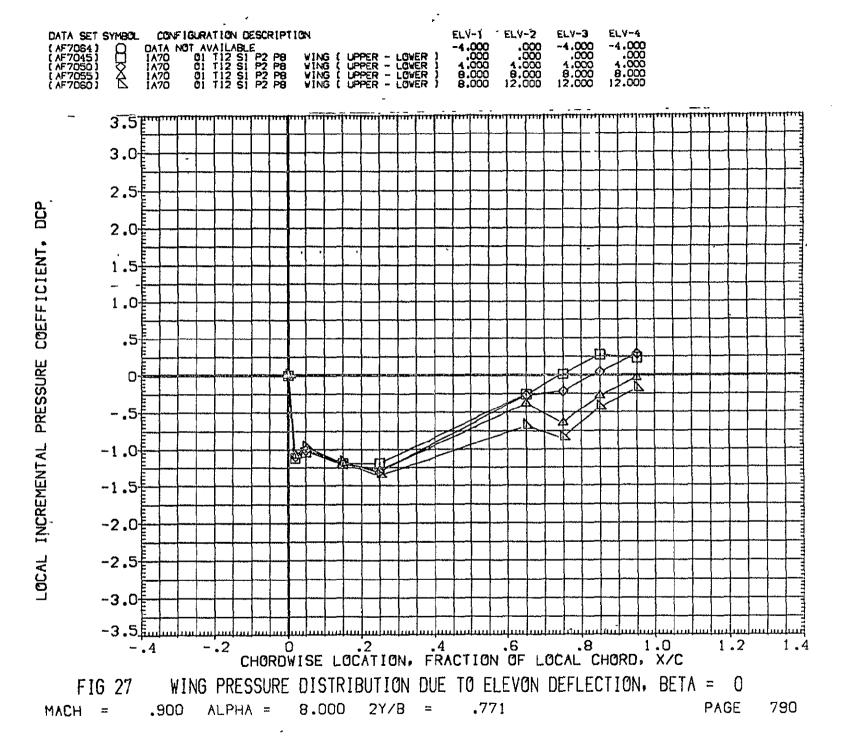


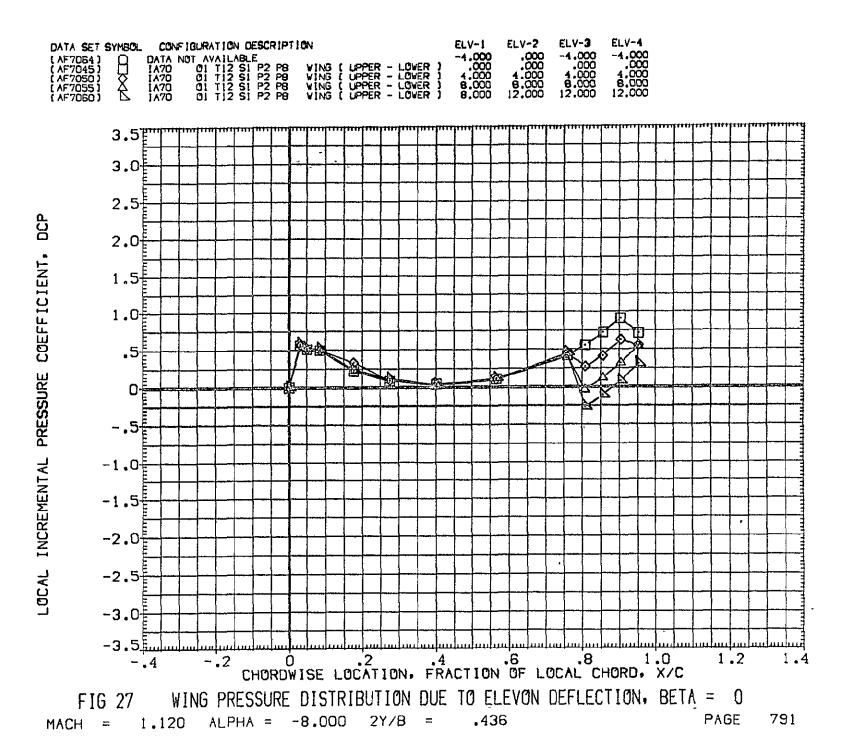


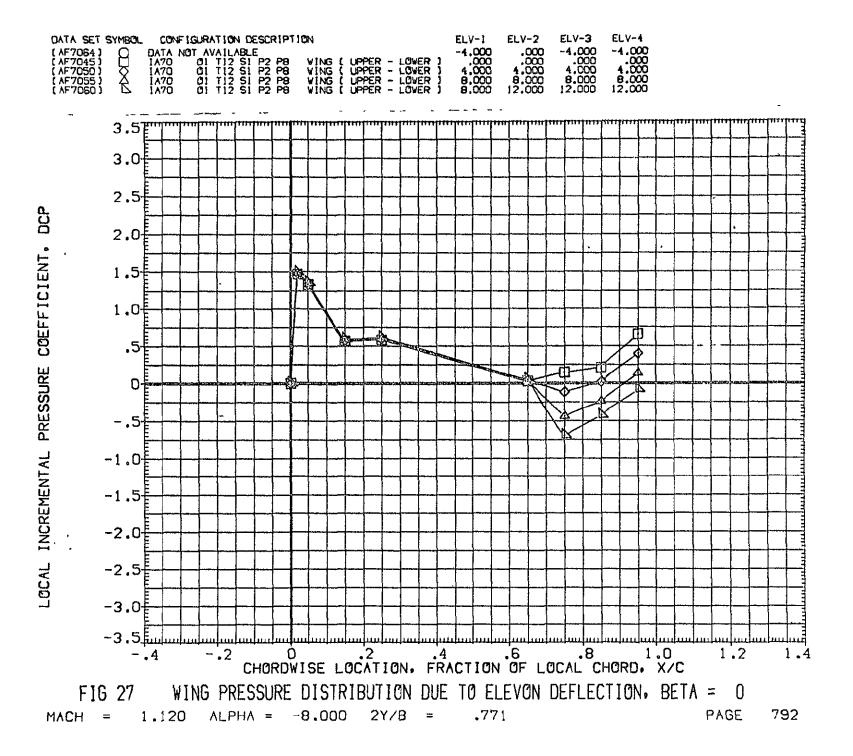


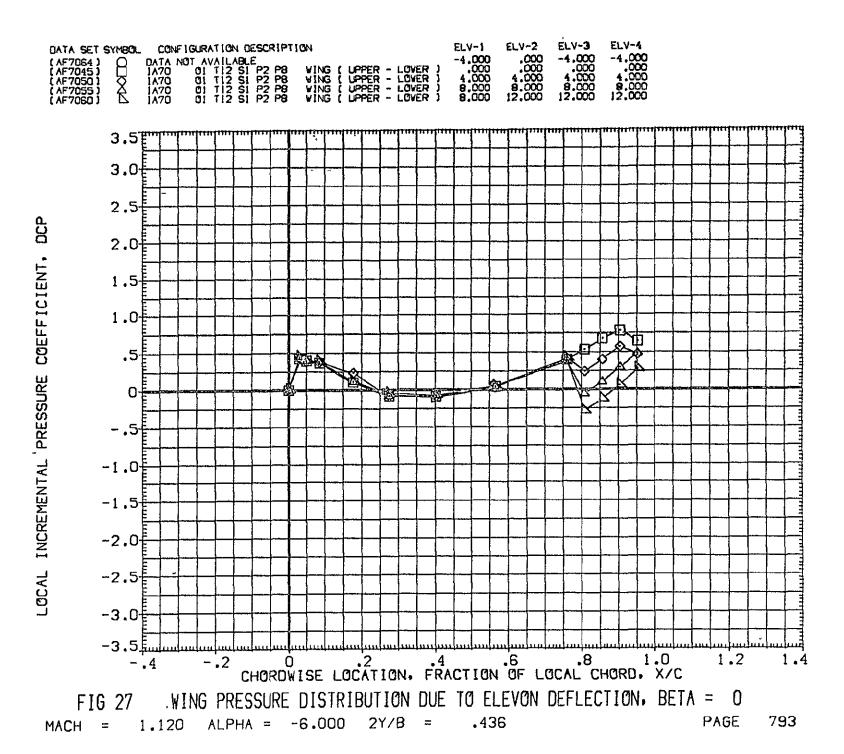


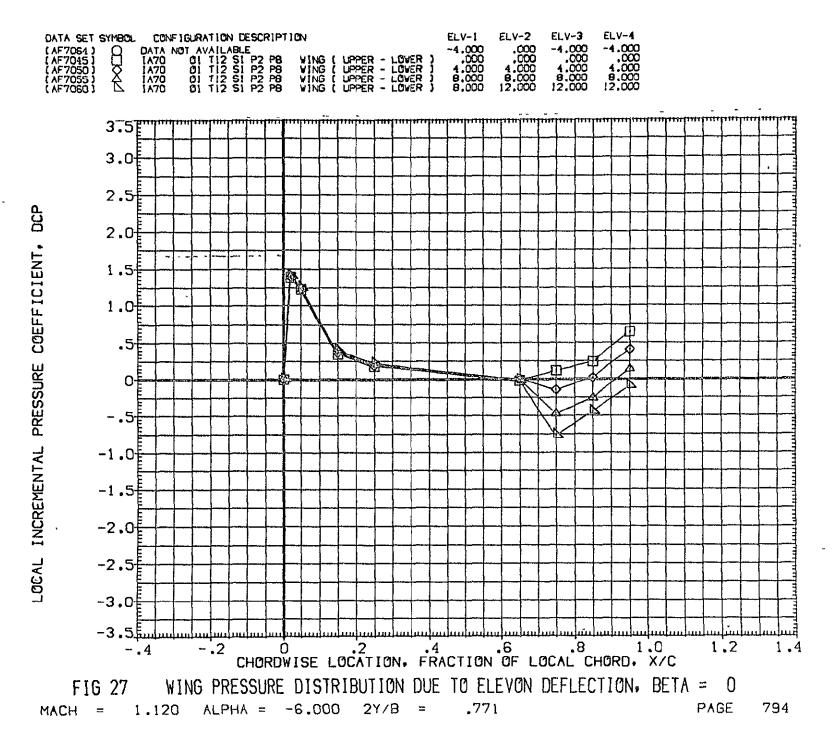


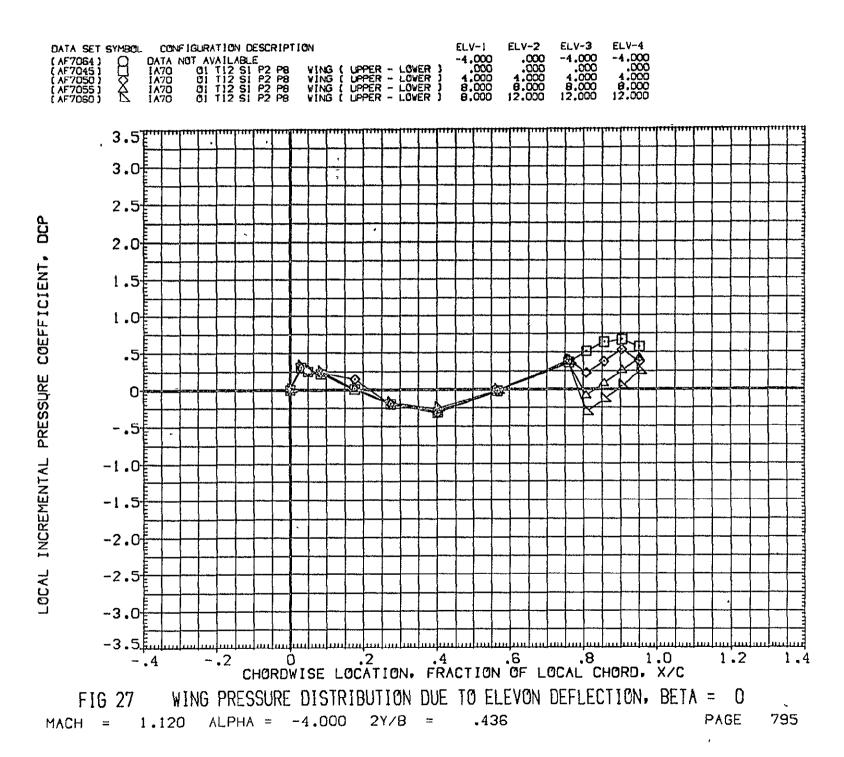


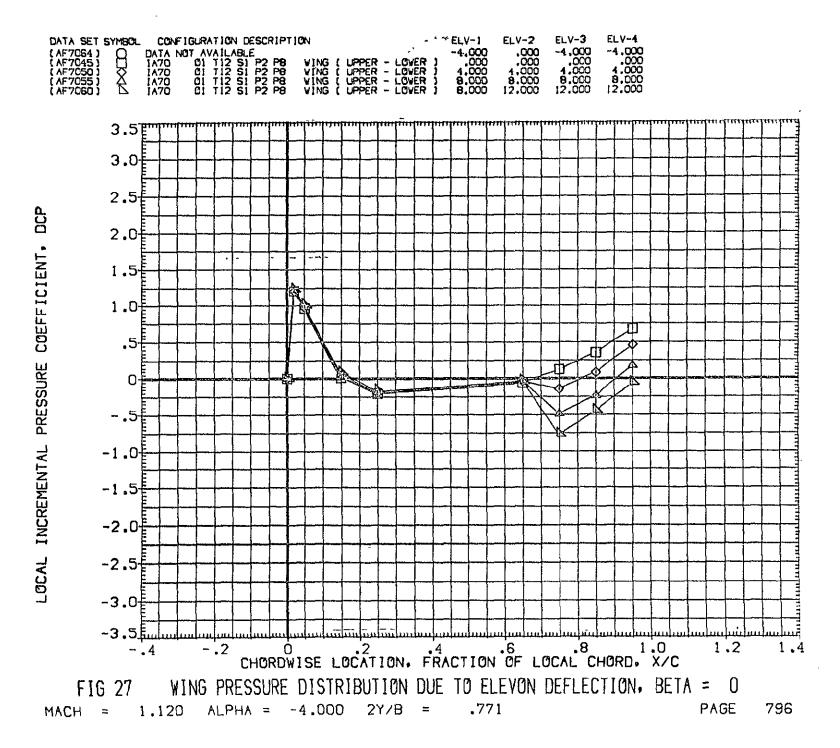


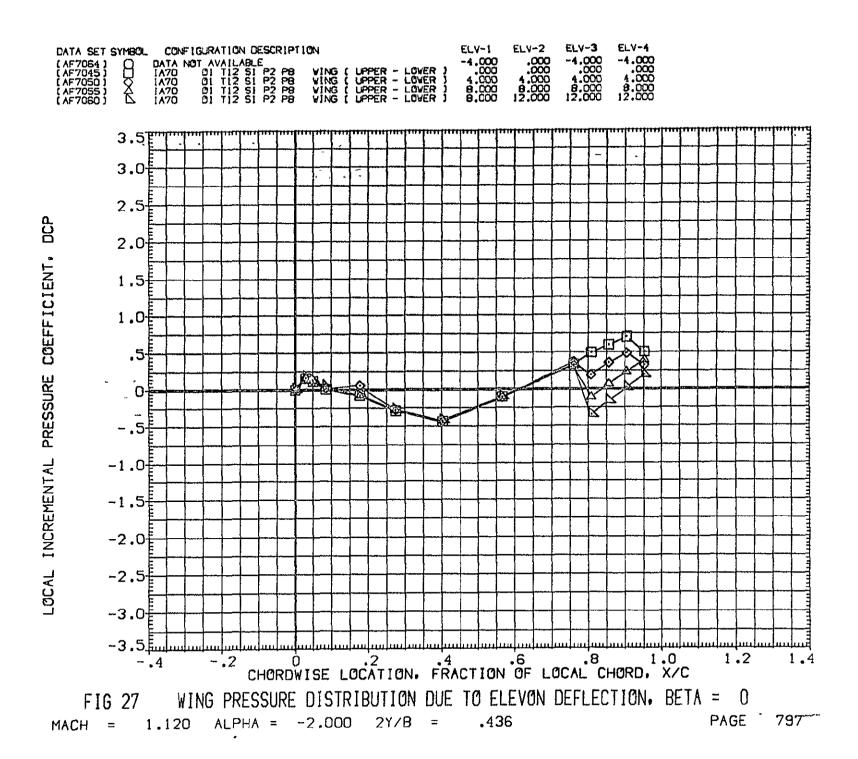


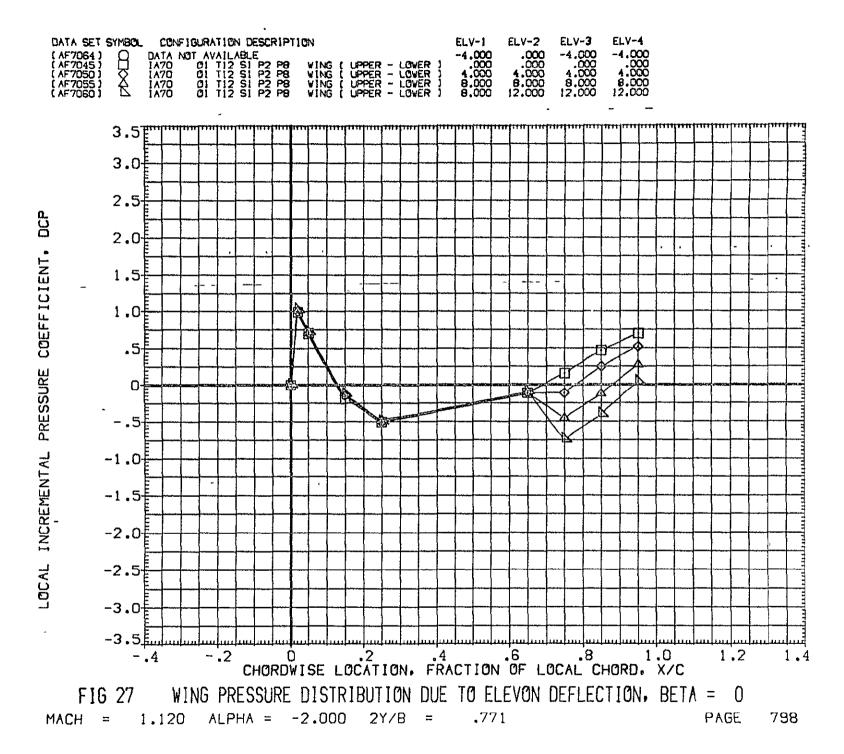


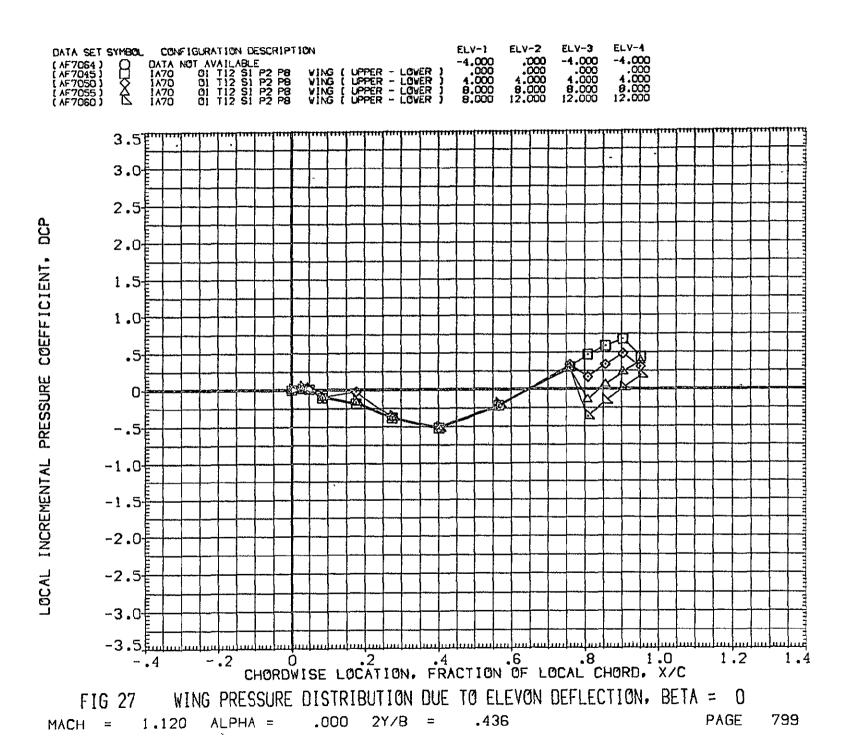


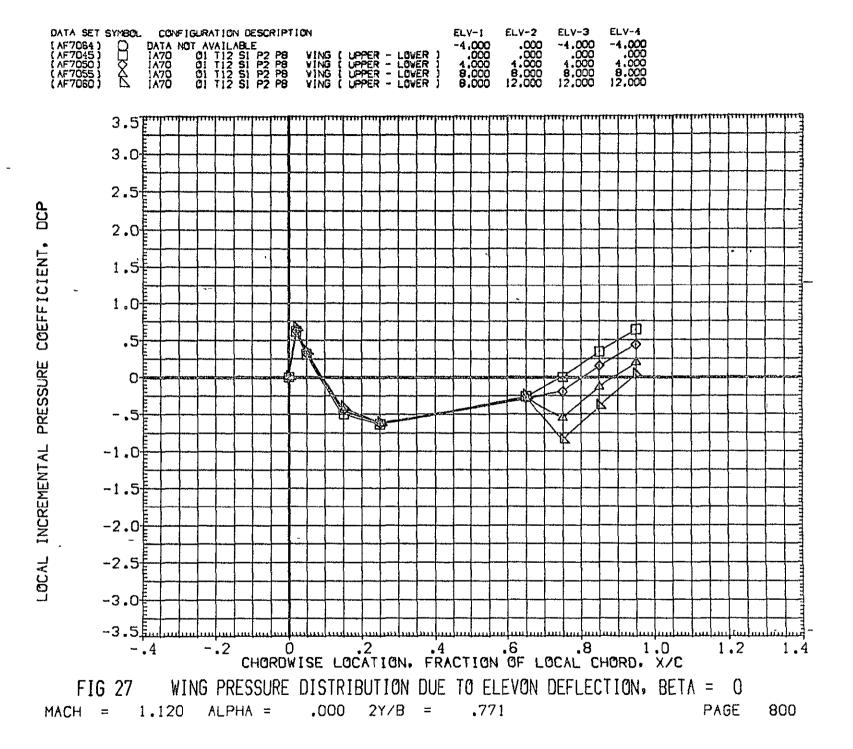


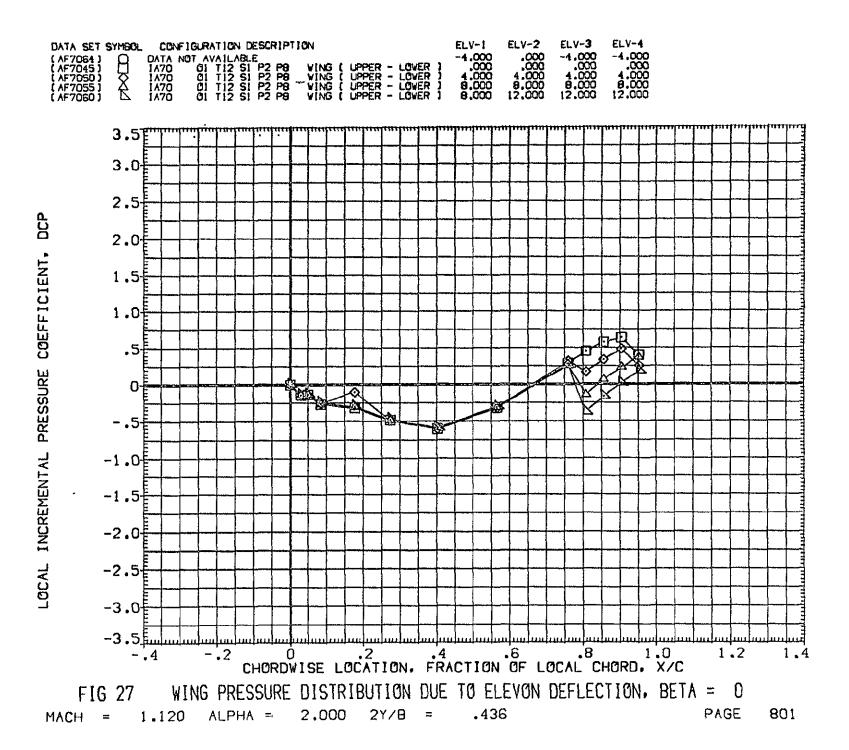


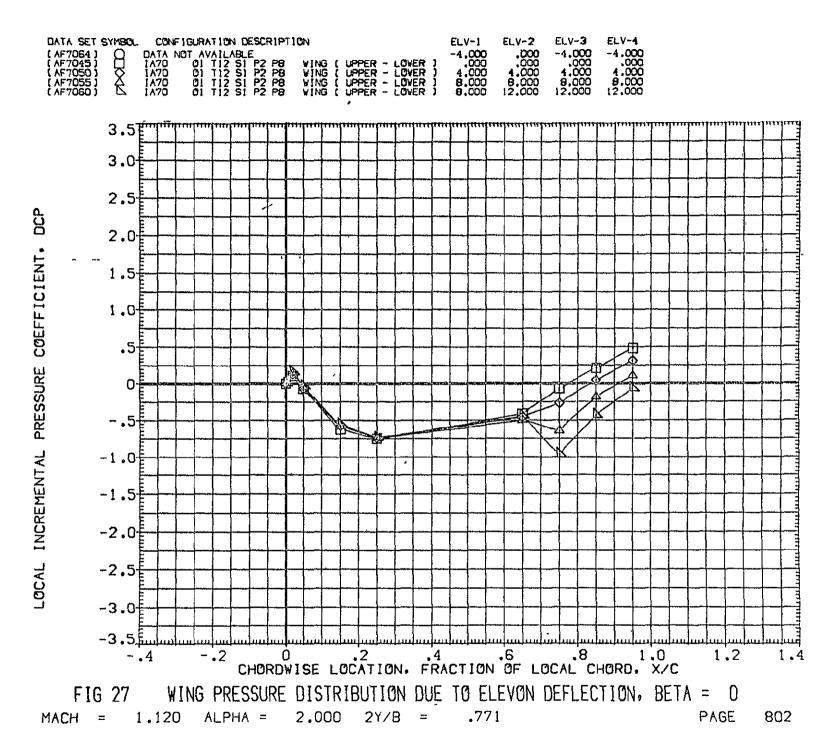


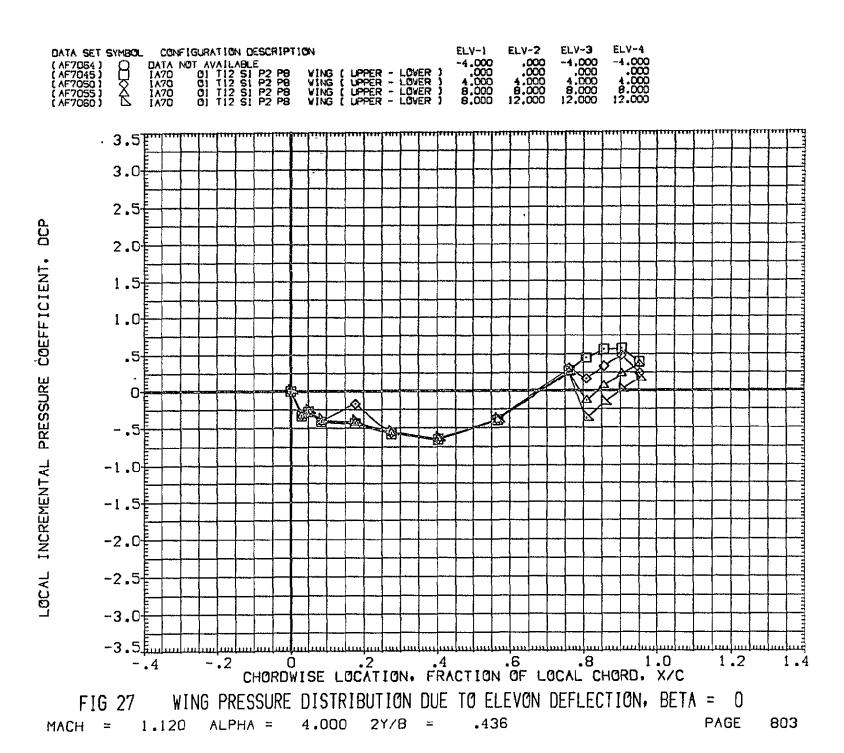


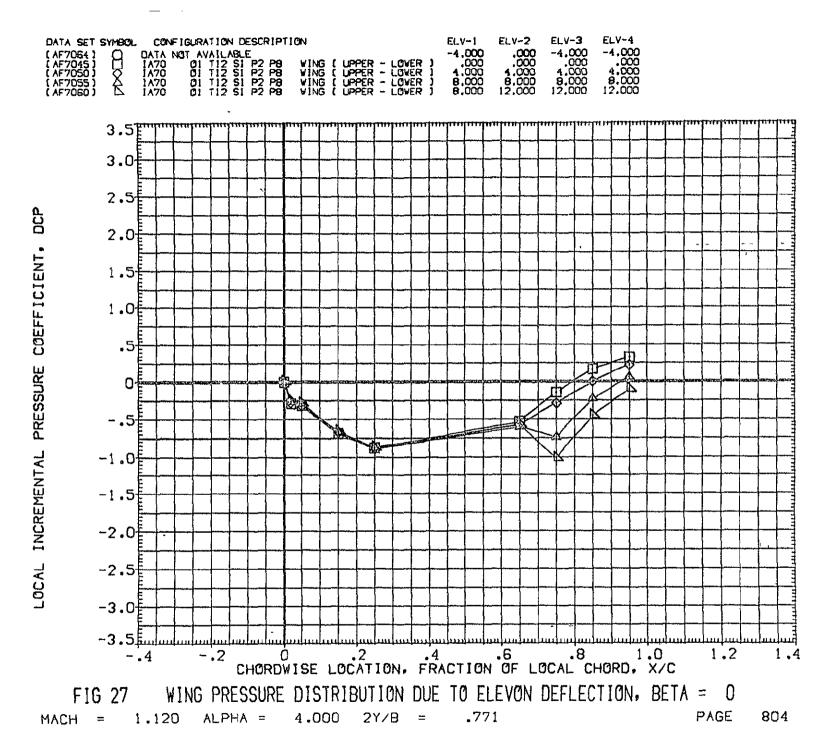


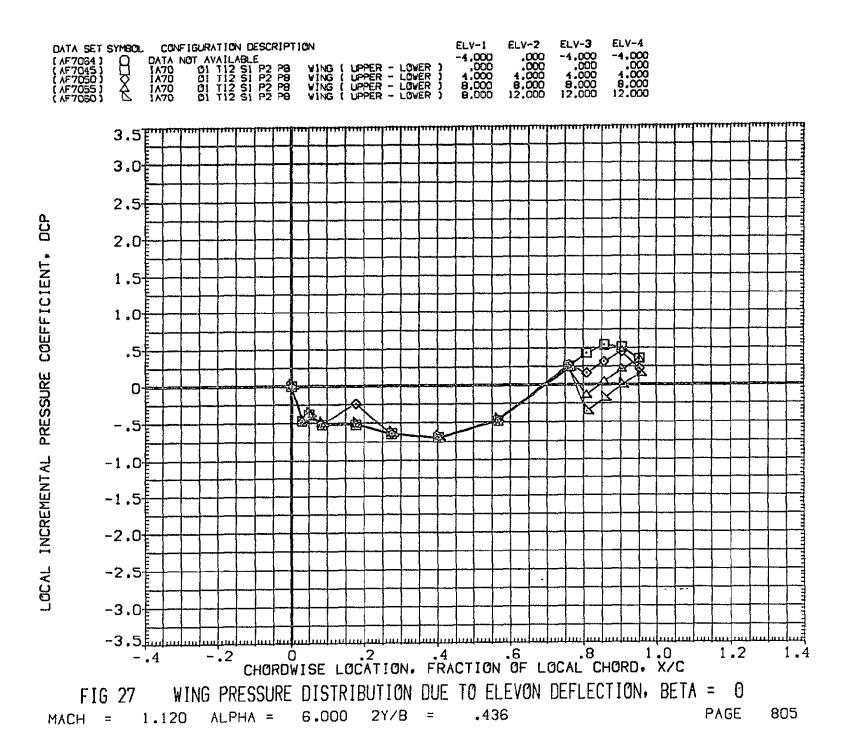


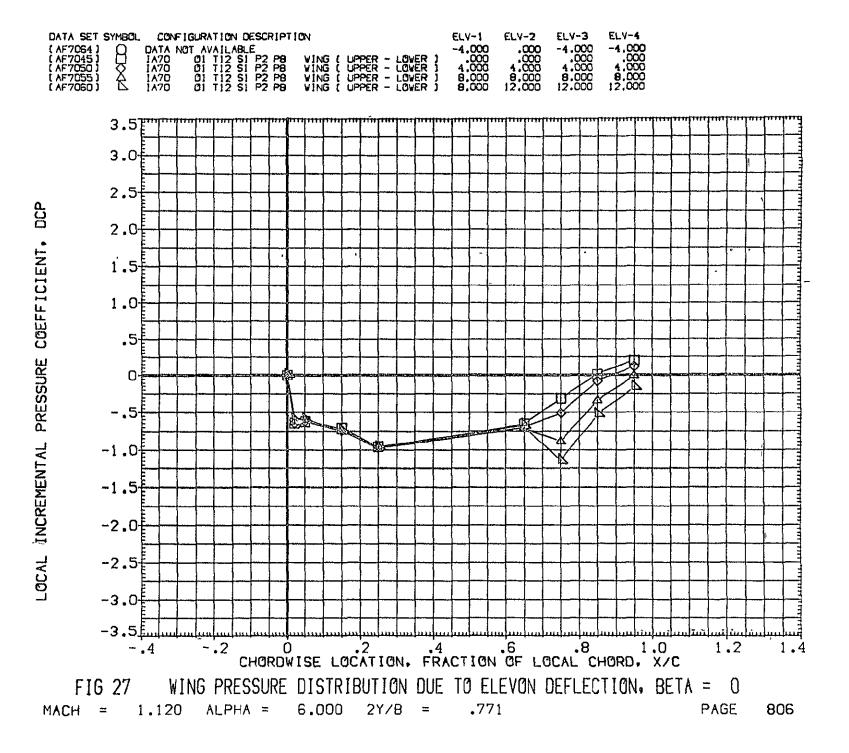


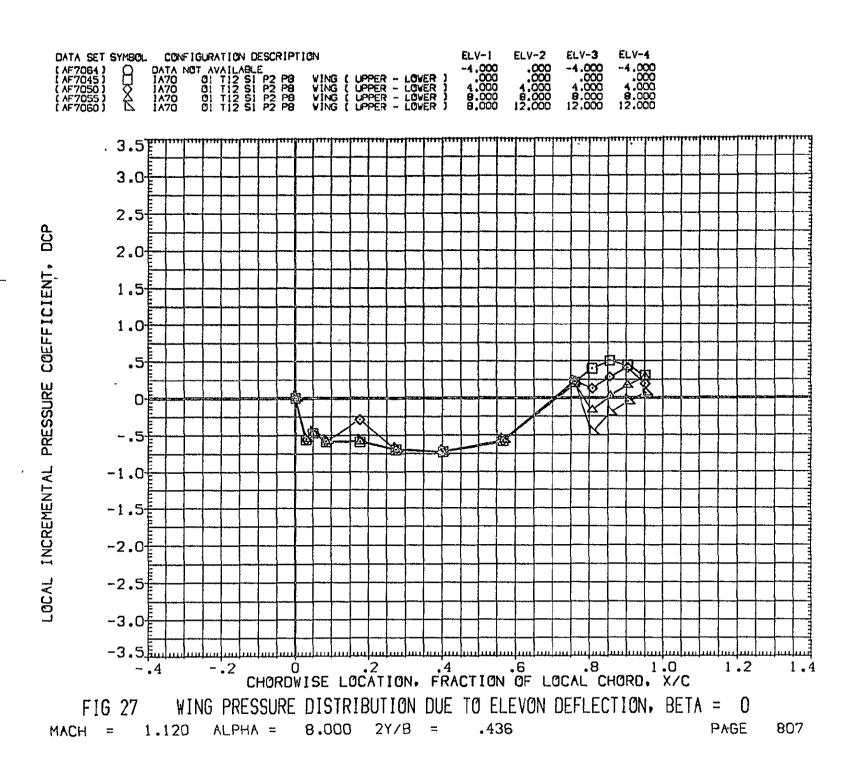


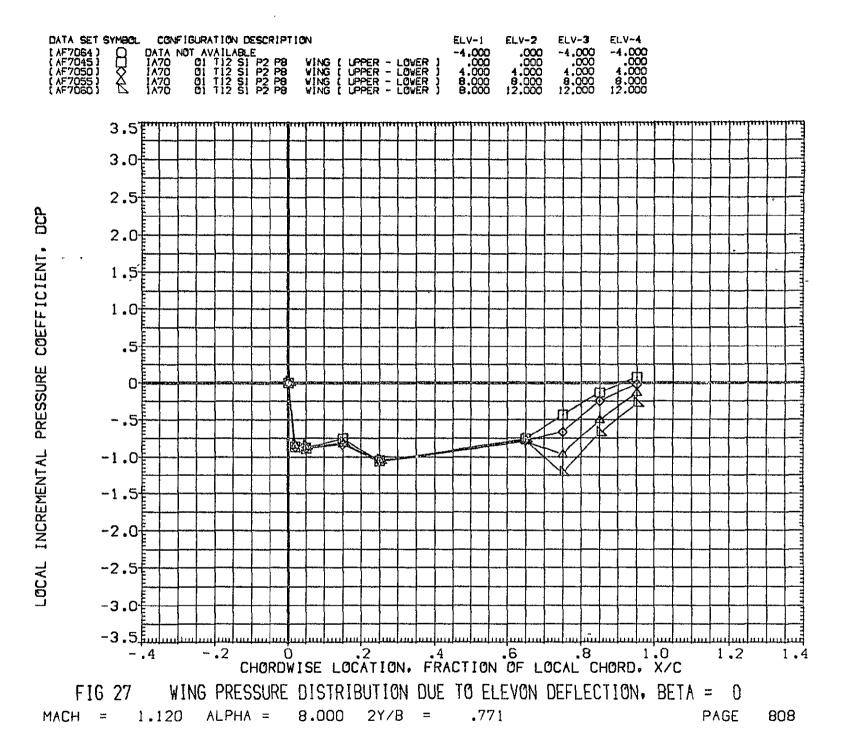


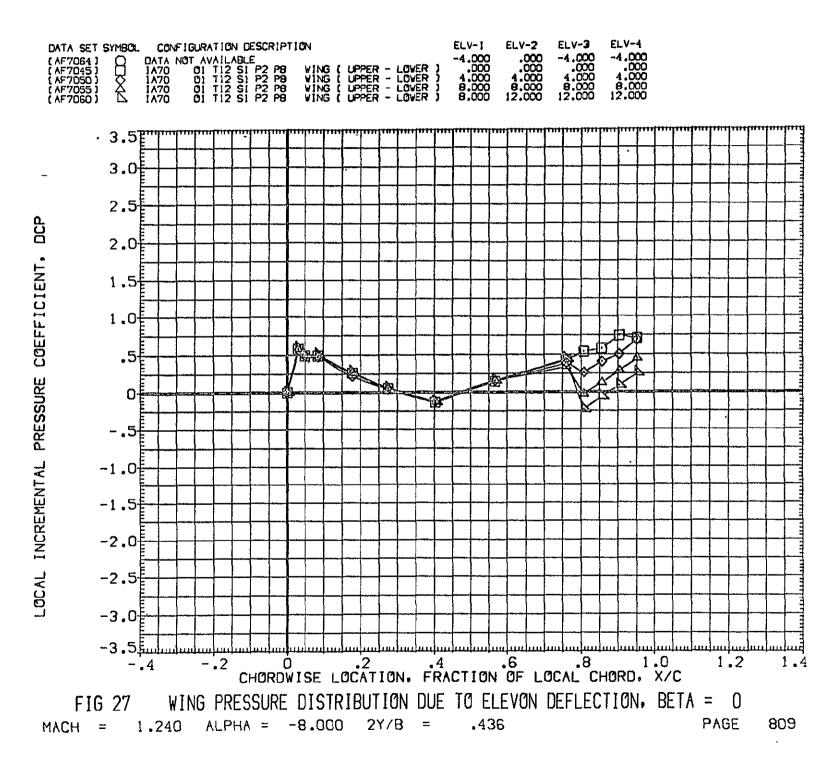


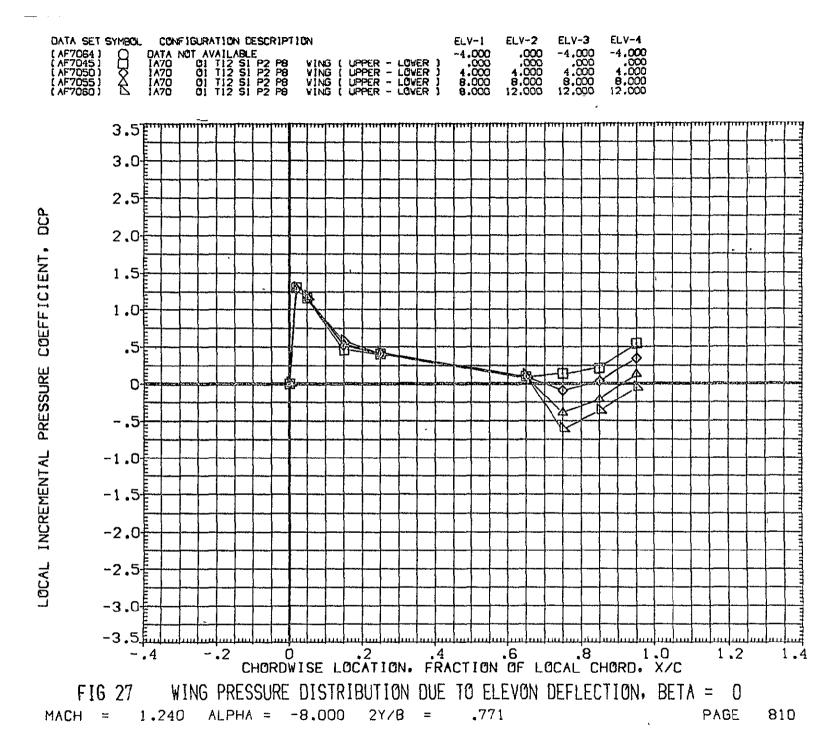


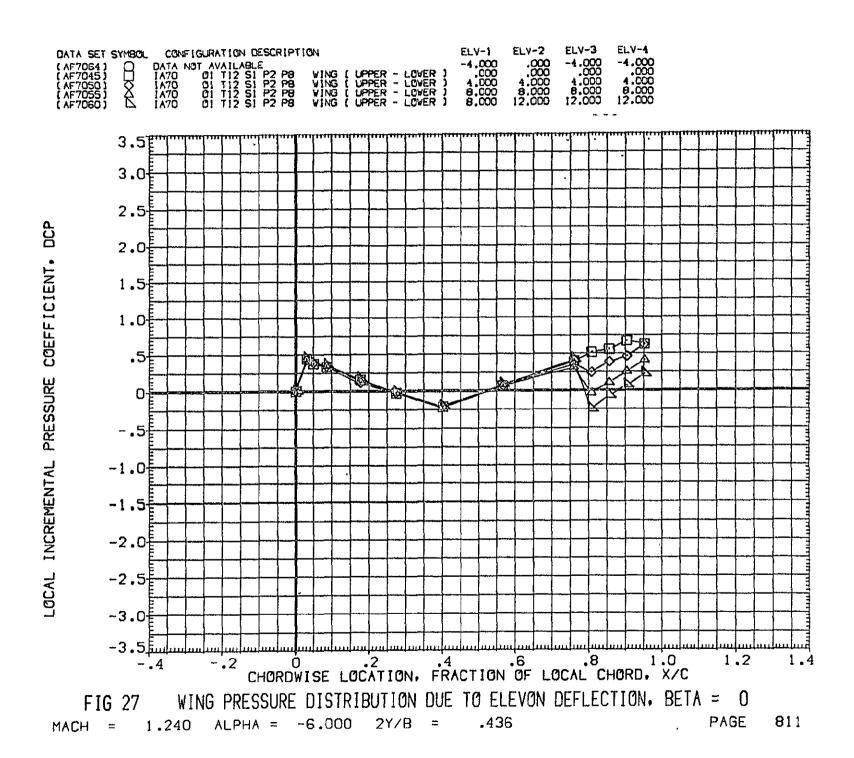












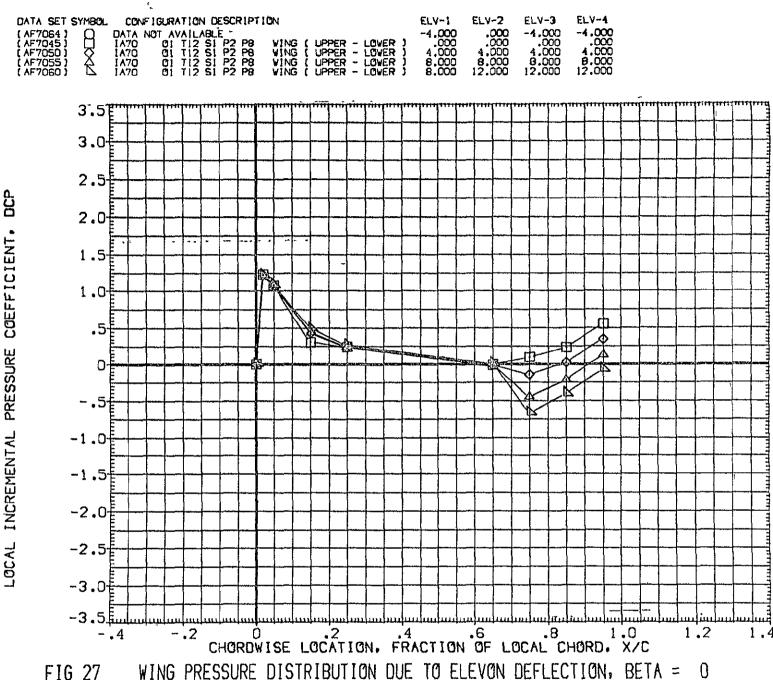
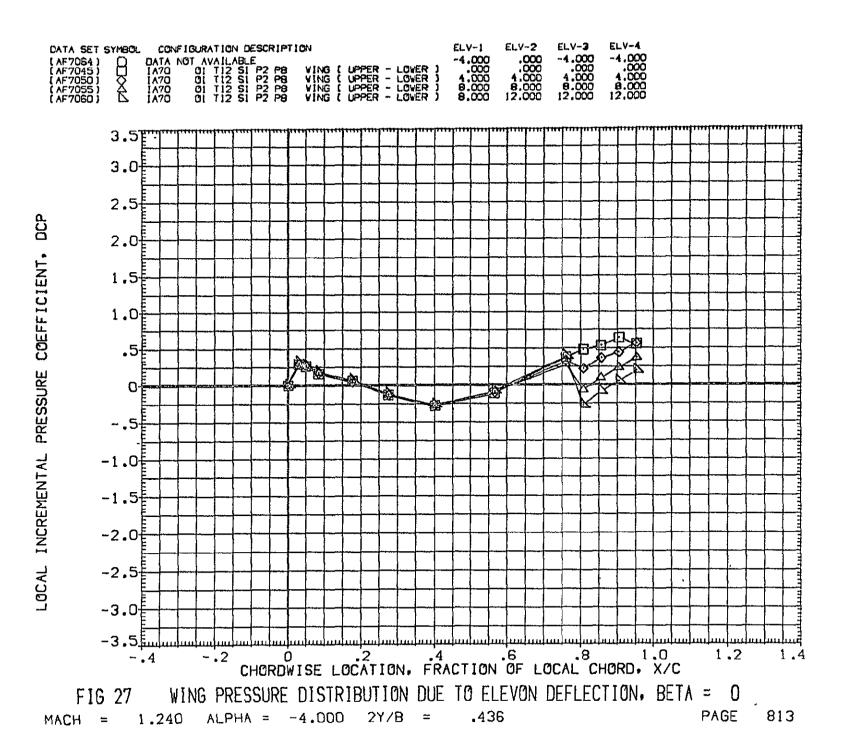
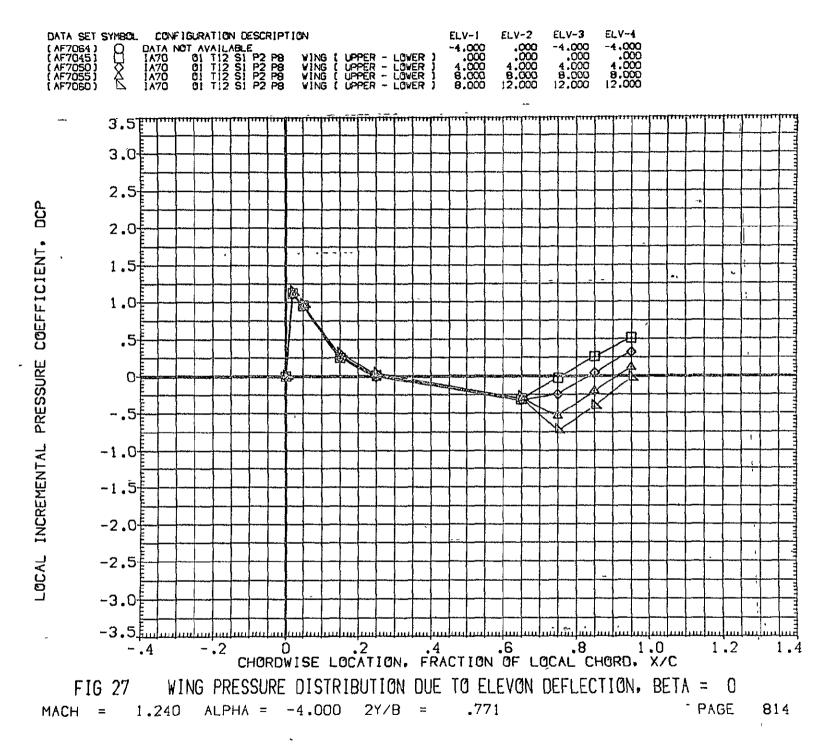
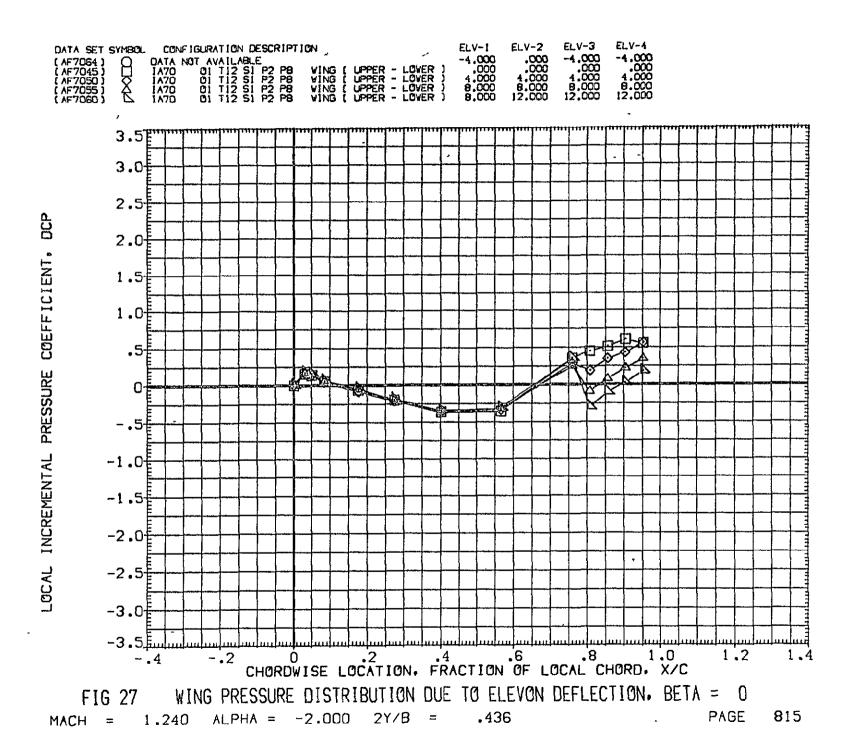


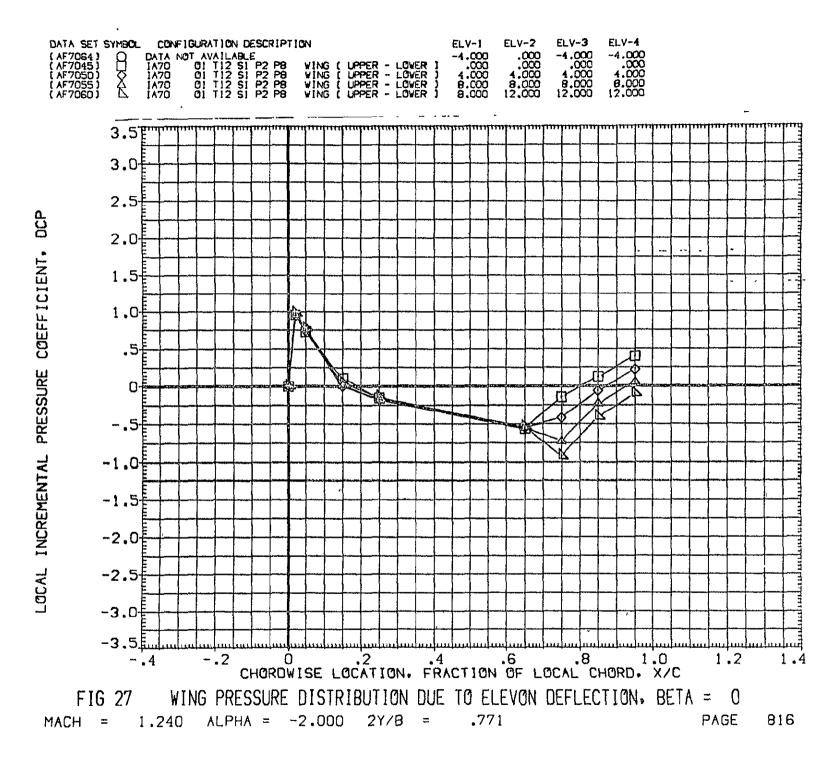
FIG 27 WING PRESSURE DISTRIBUTION DUE TO ELEVON DEFLECTION, BETA = 0

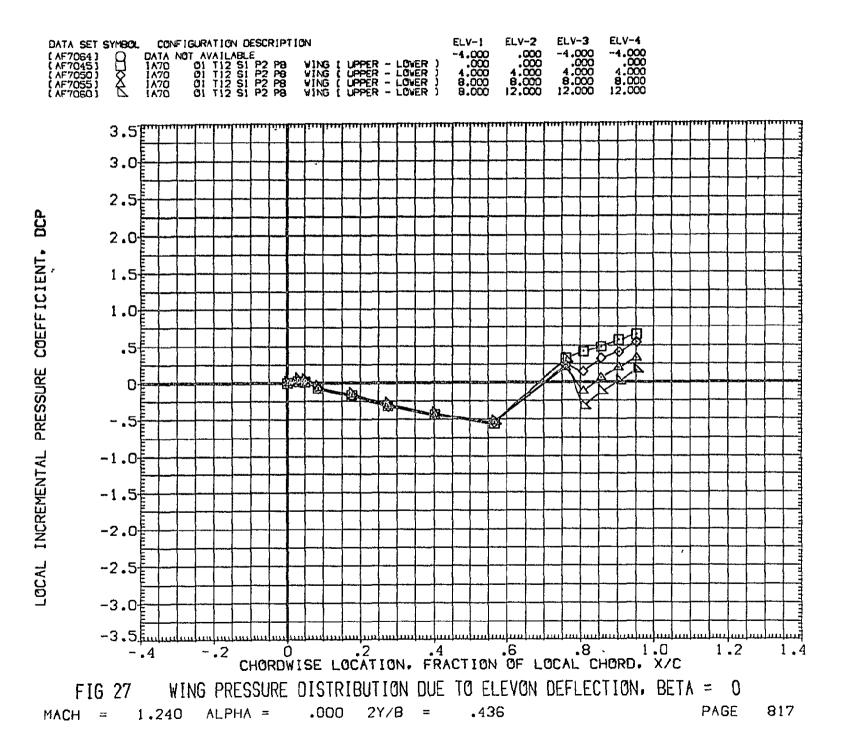
MACH = 1.240 ALPHA = -6.000 2Y/B = .771 PAGE 812

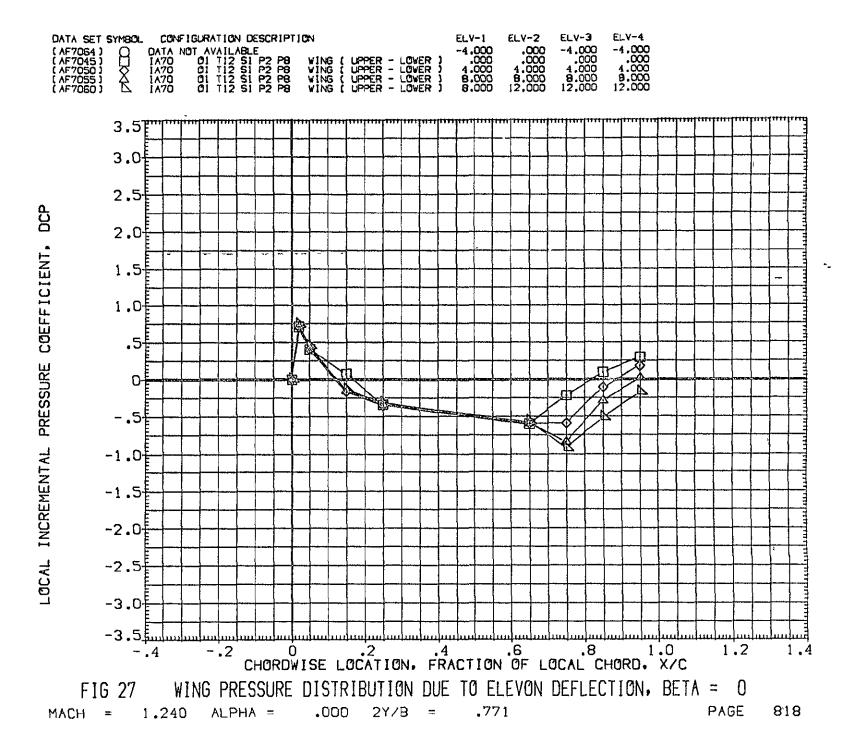


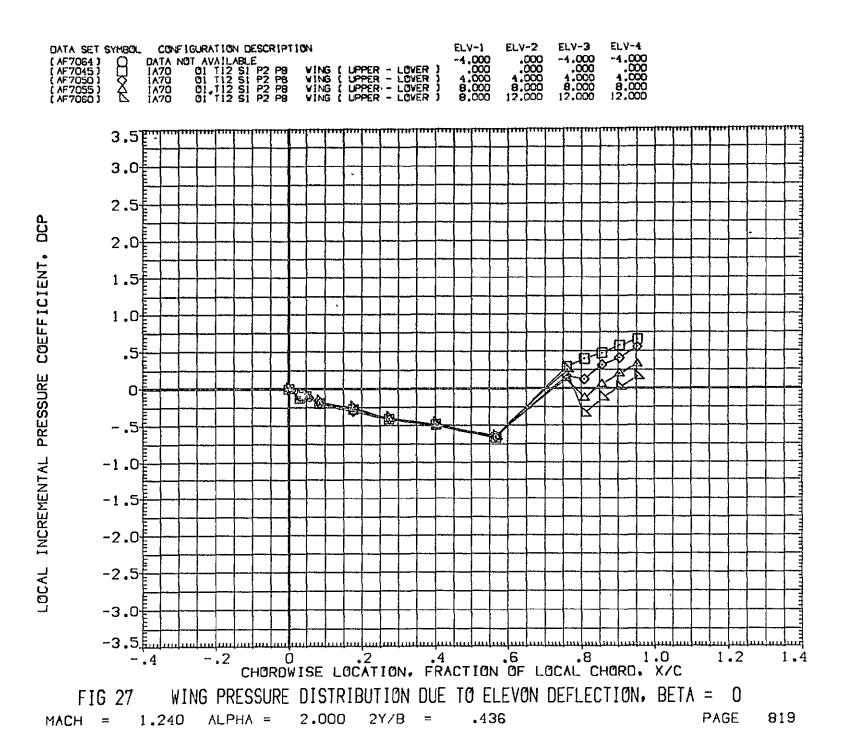


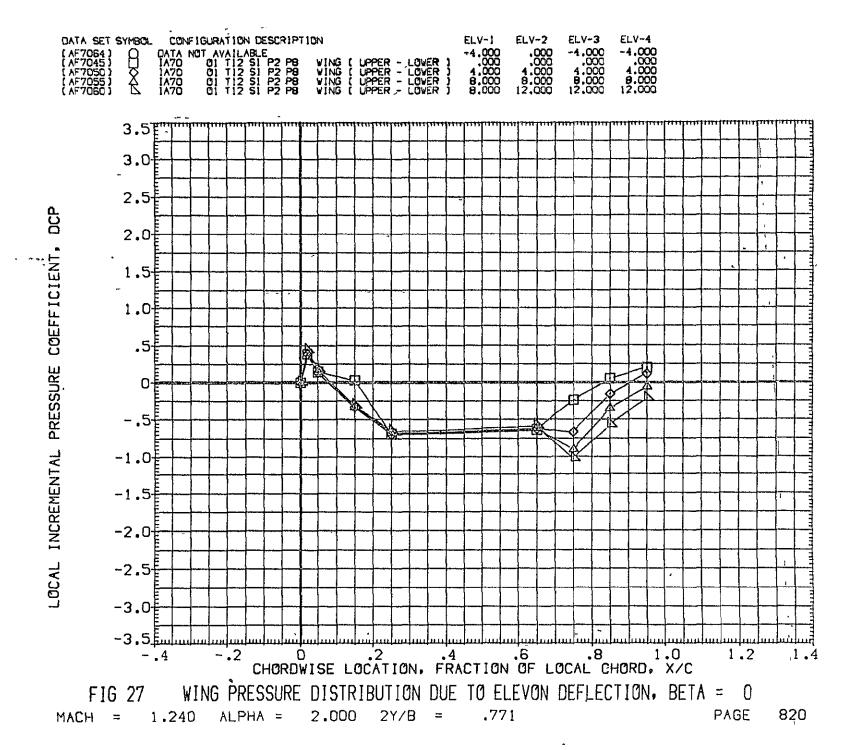


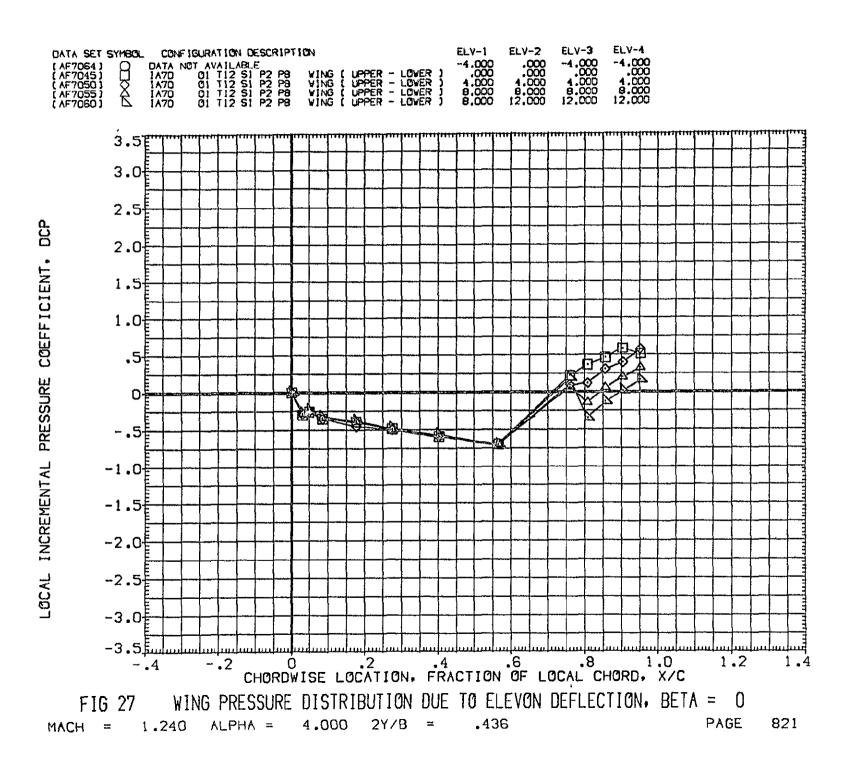


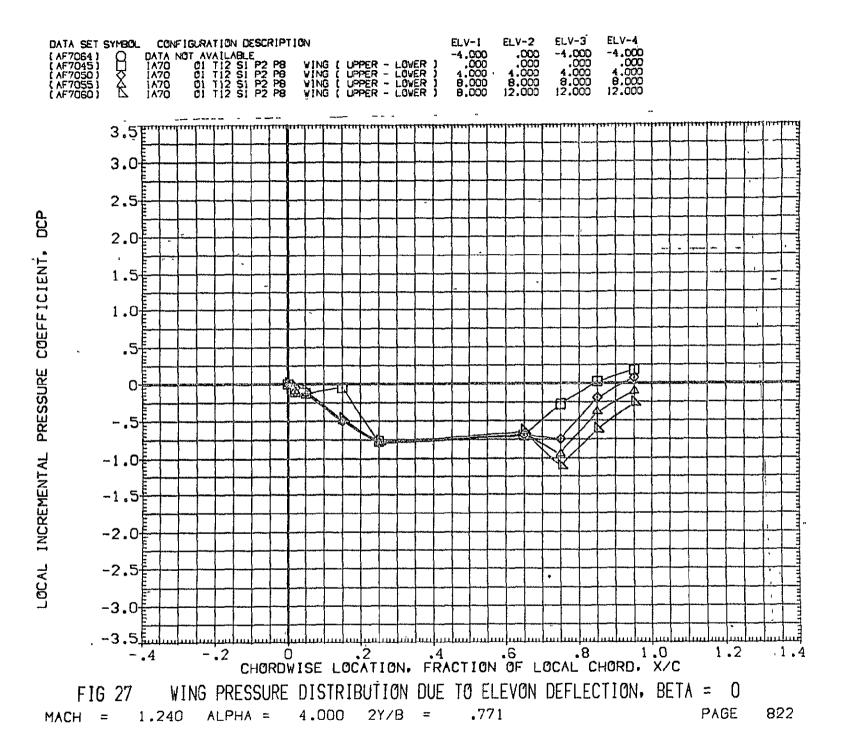


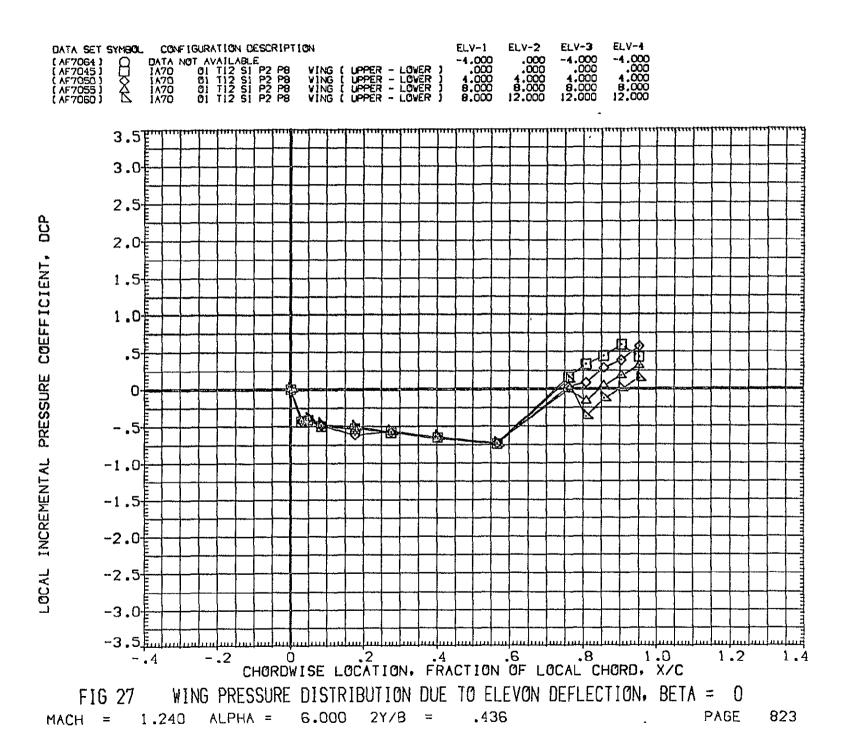


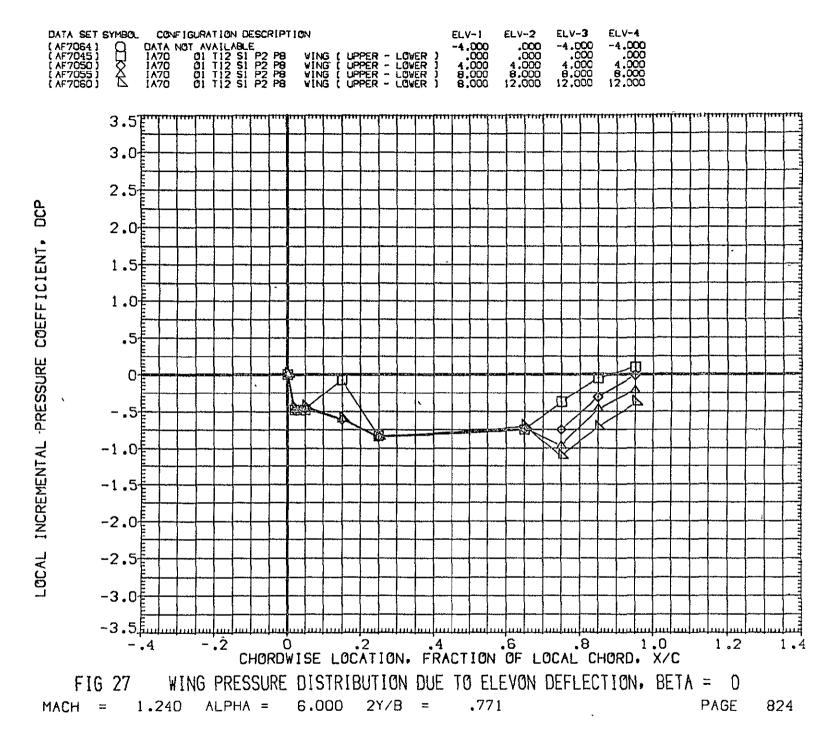


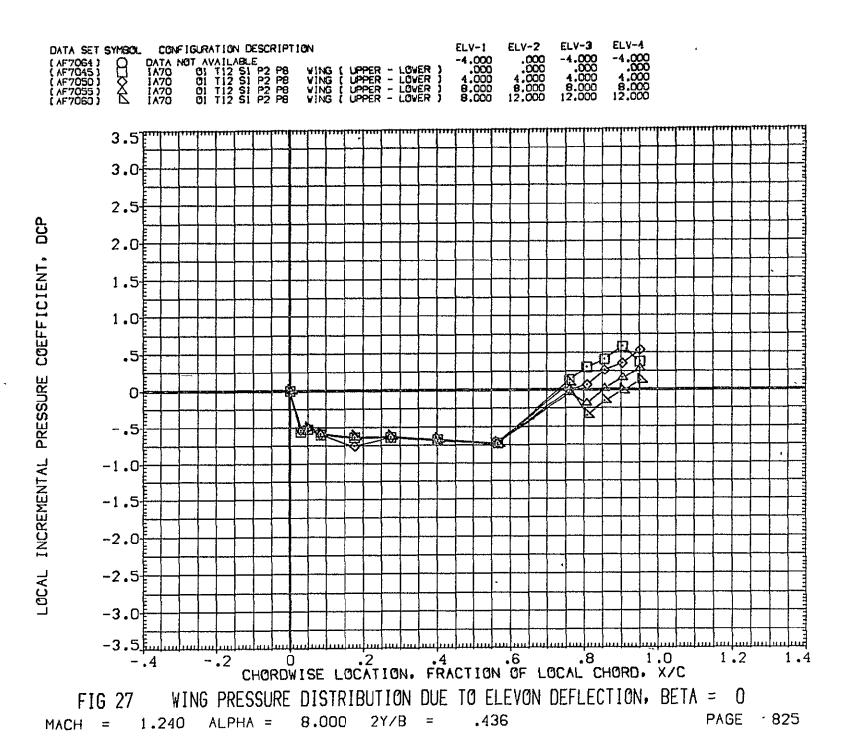


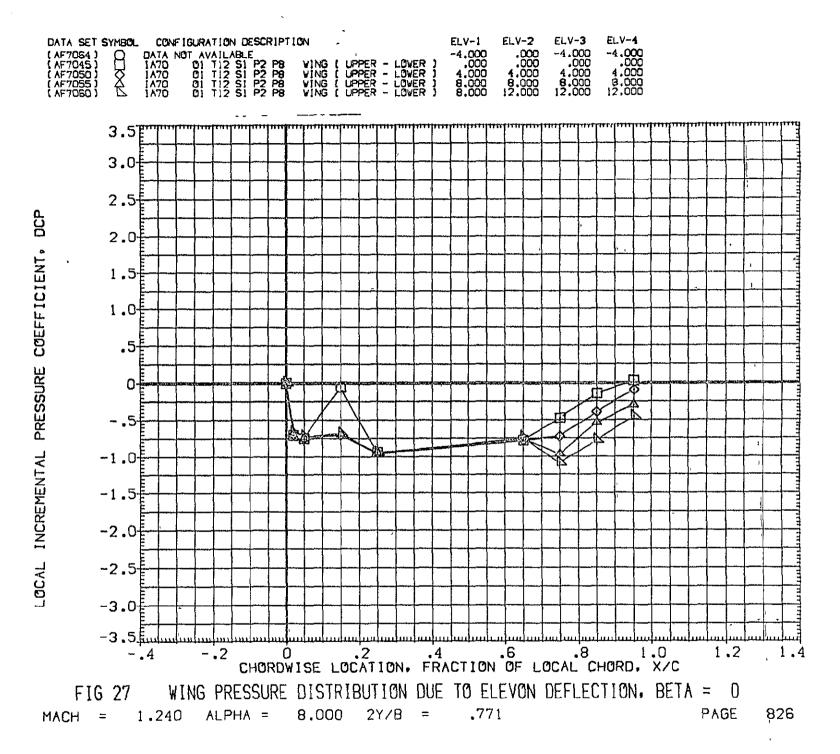


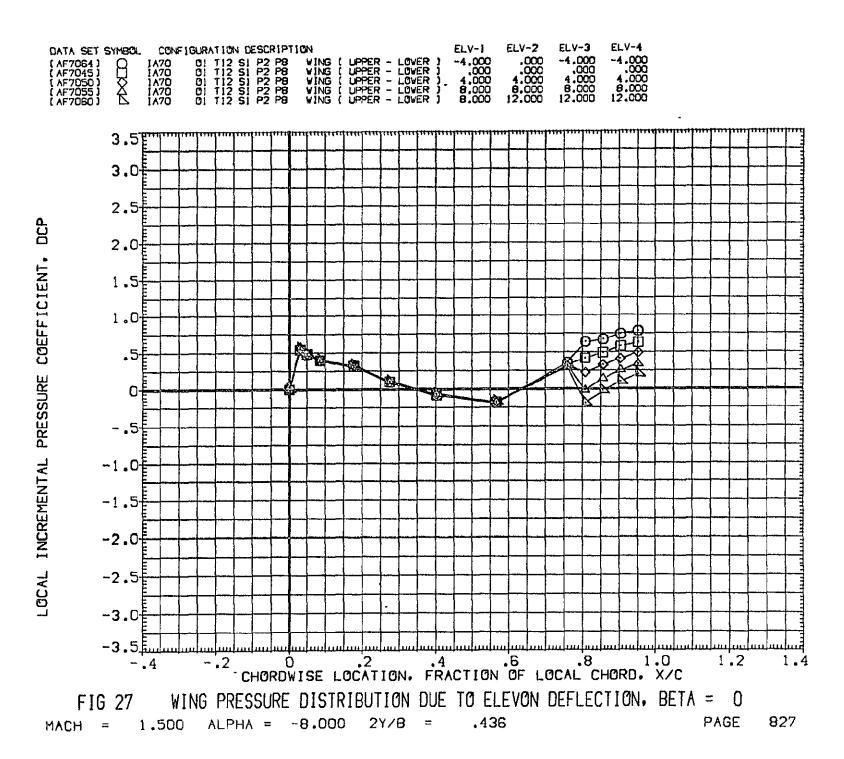


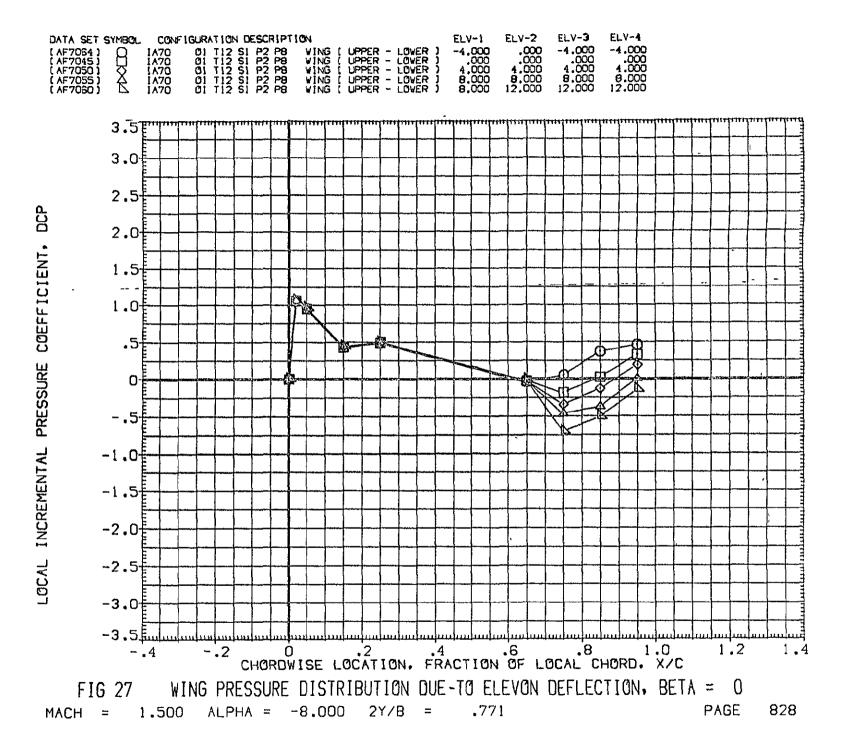


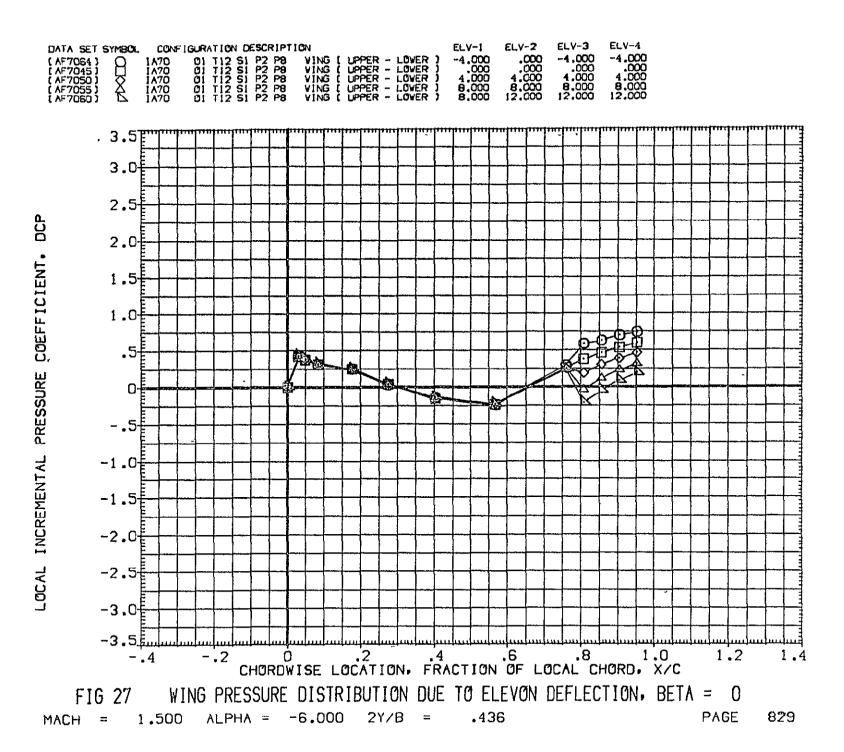


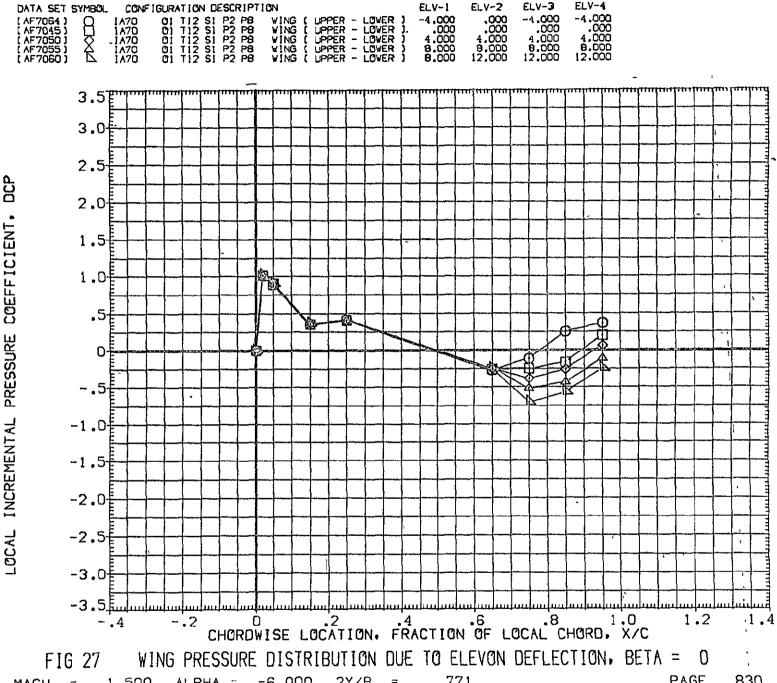




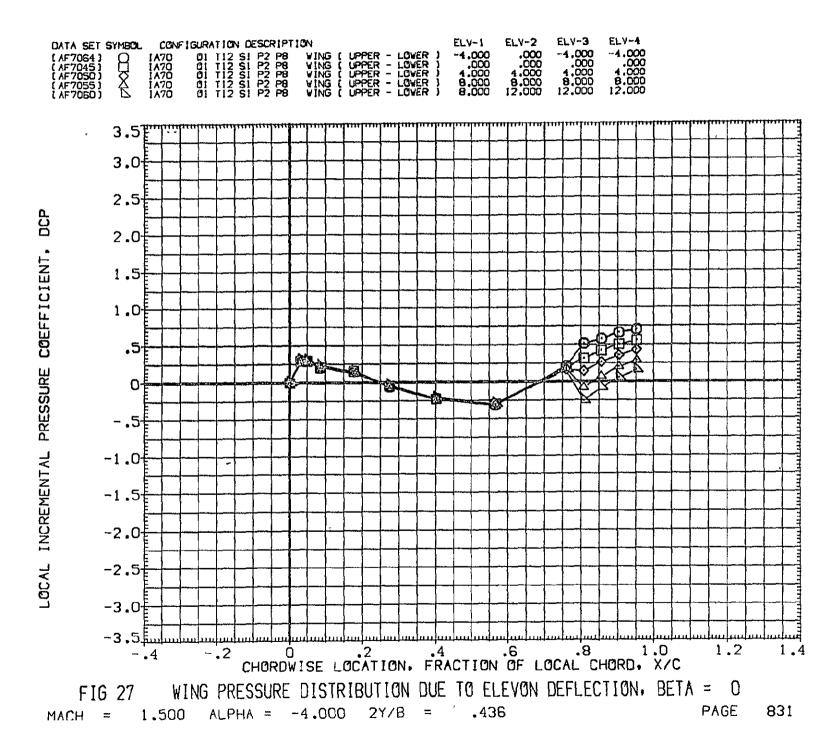


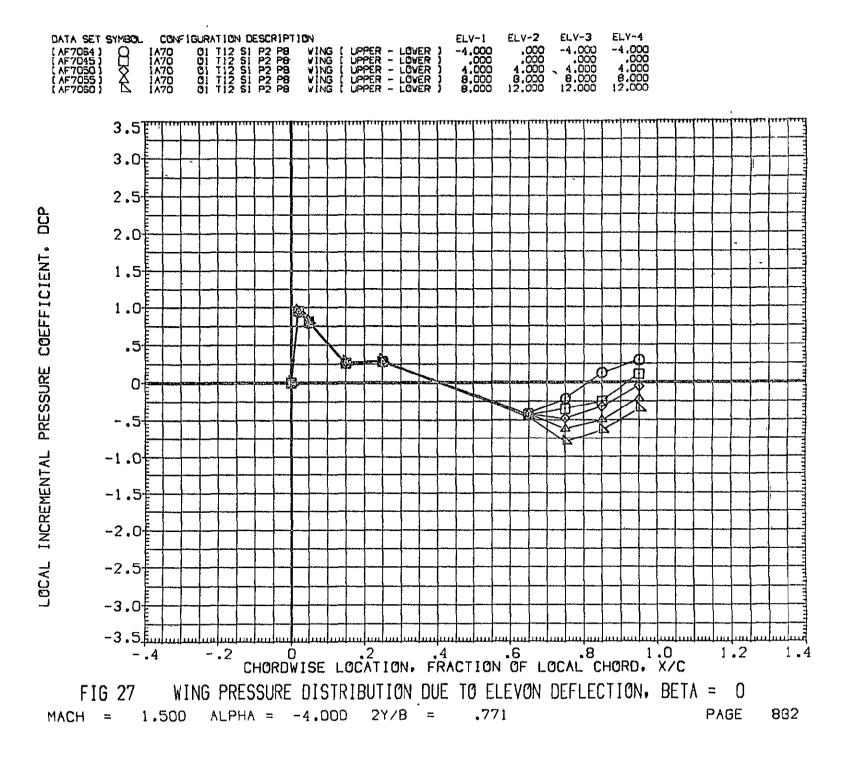


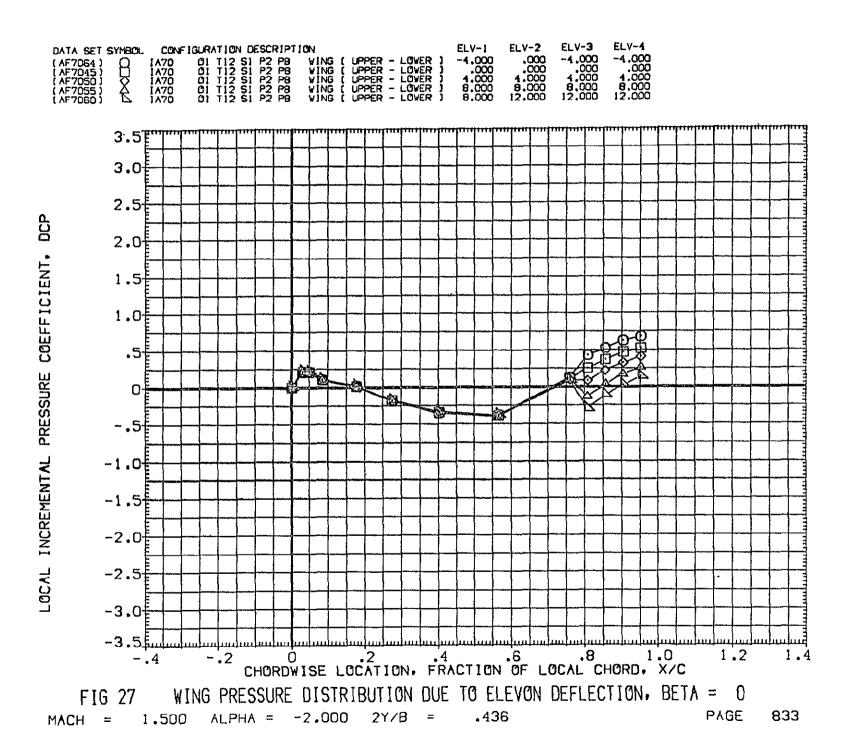


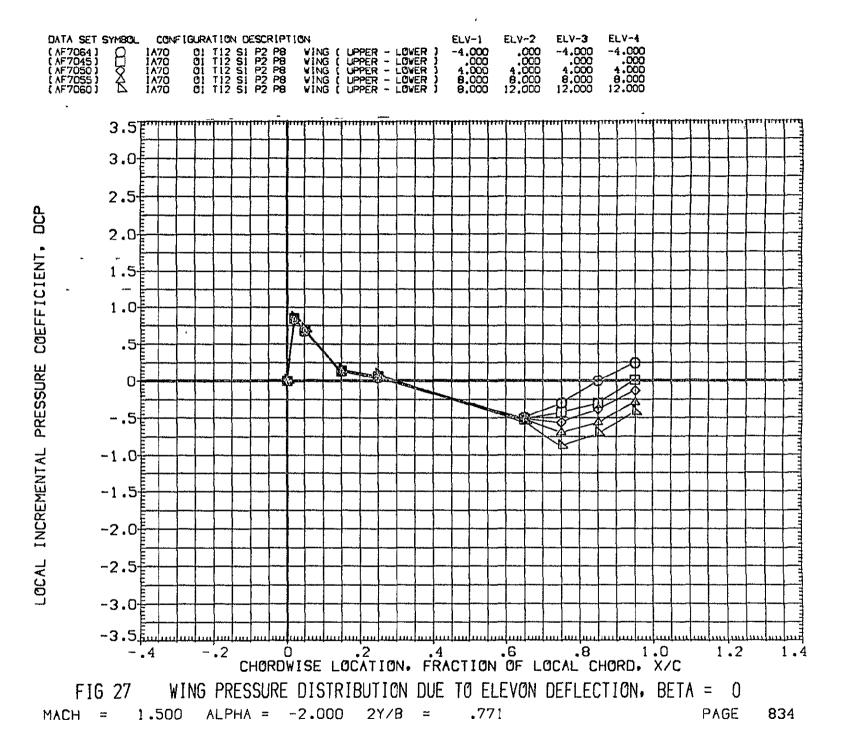


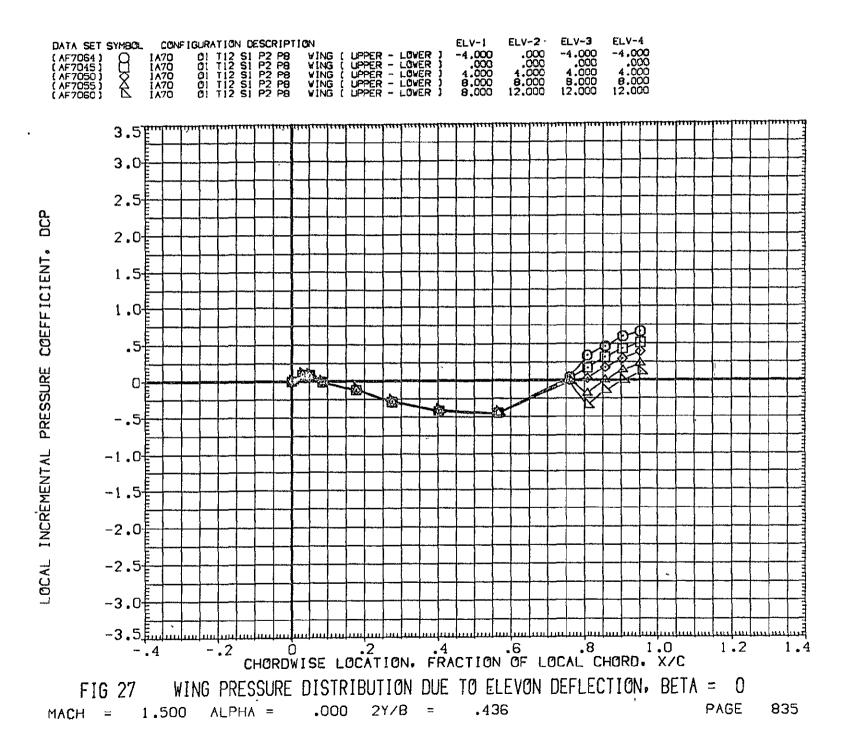
MACH = 1.500 ALPHA = -6.000 2Y/B = PAGE 830 .771

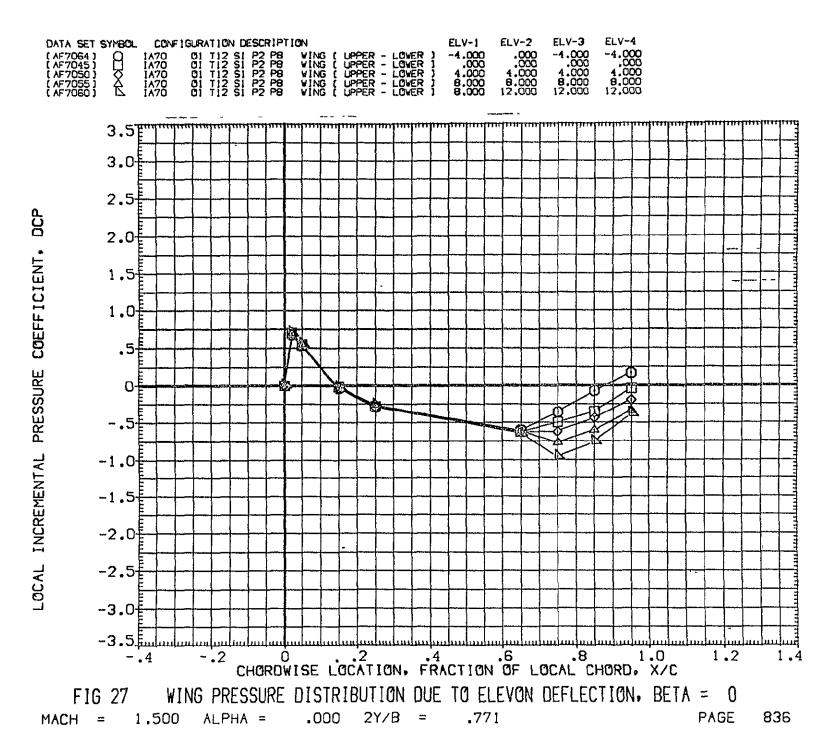


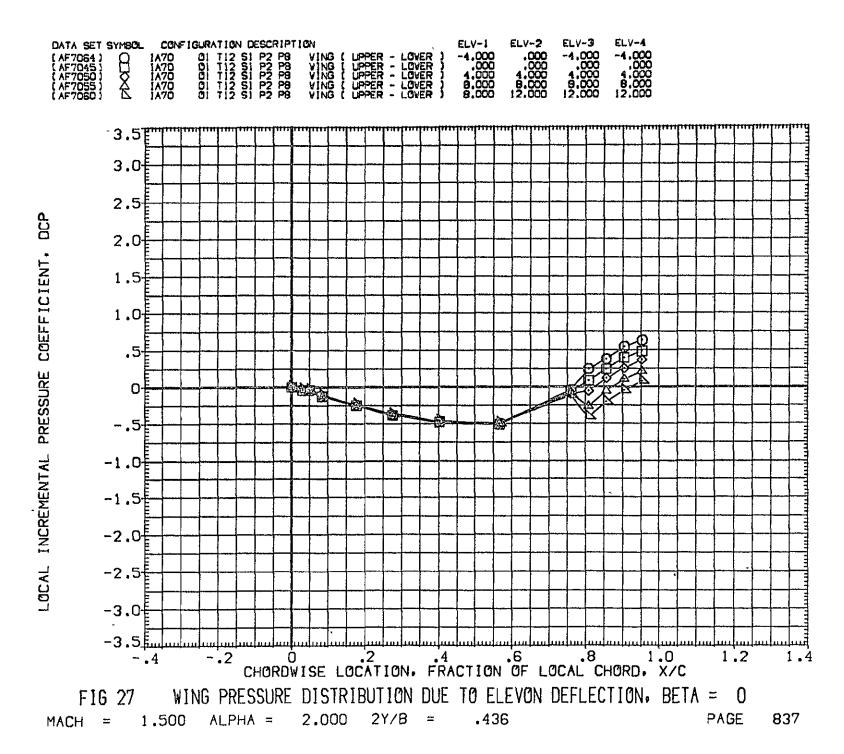


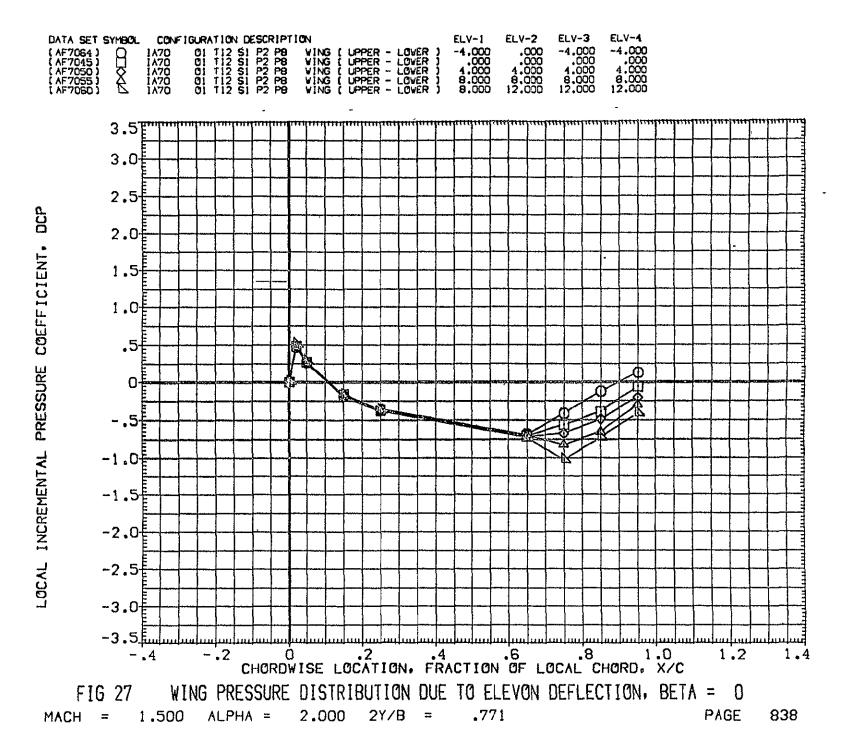


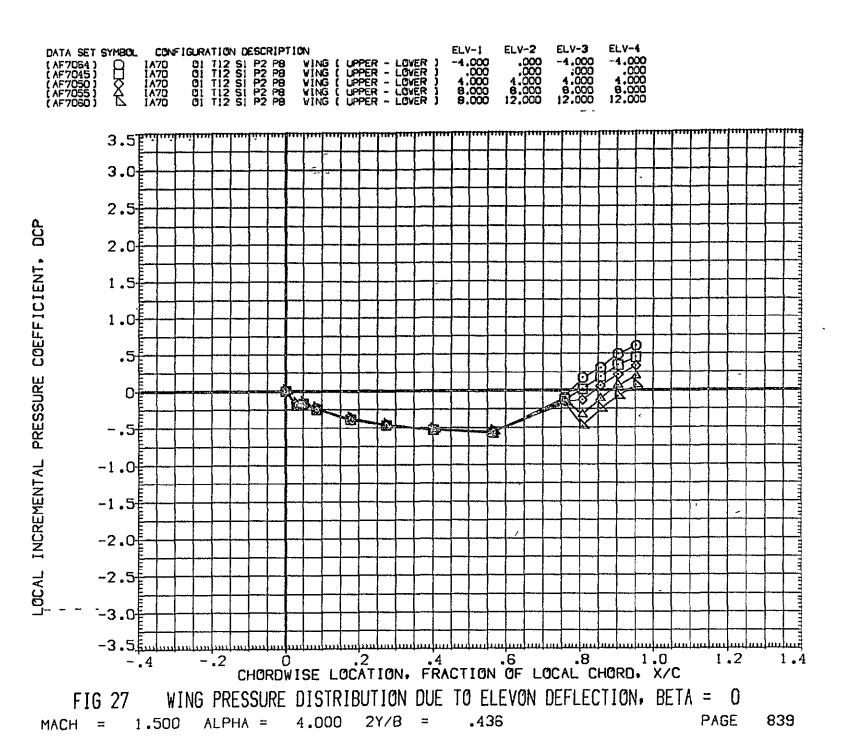


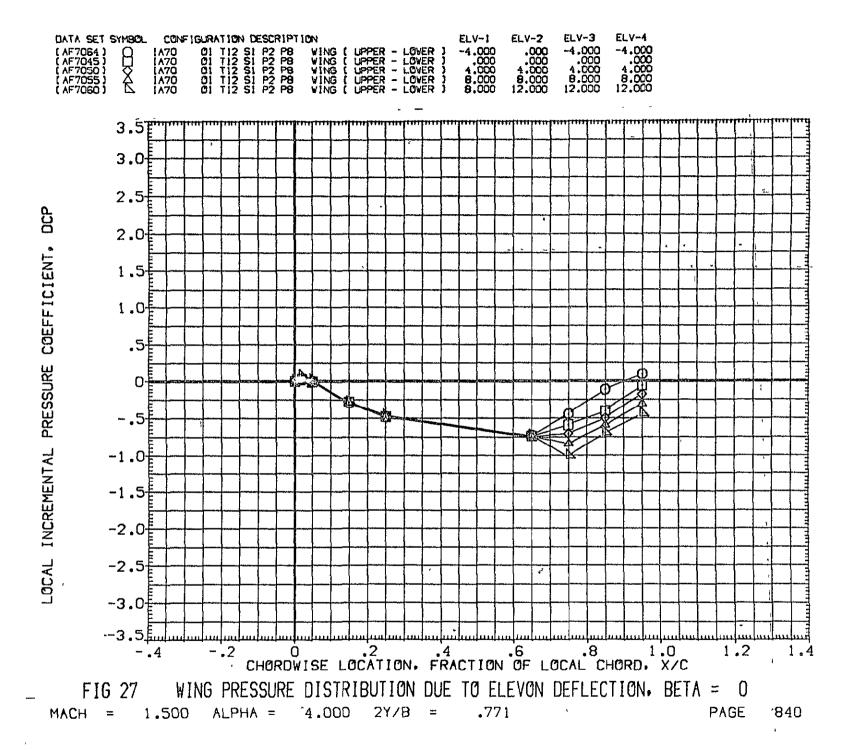


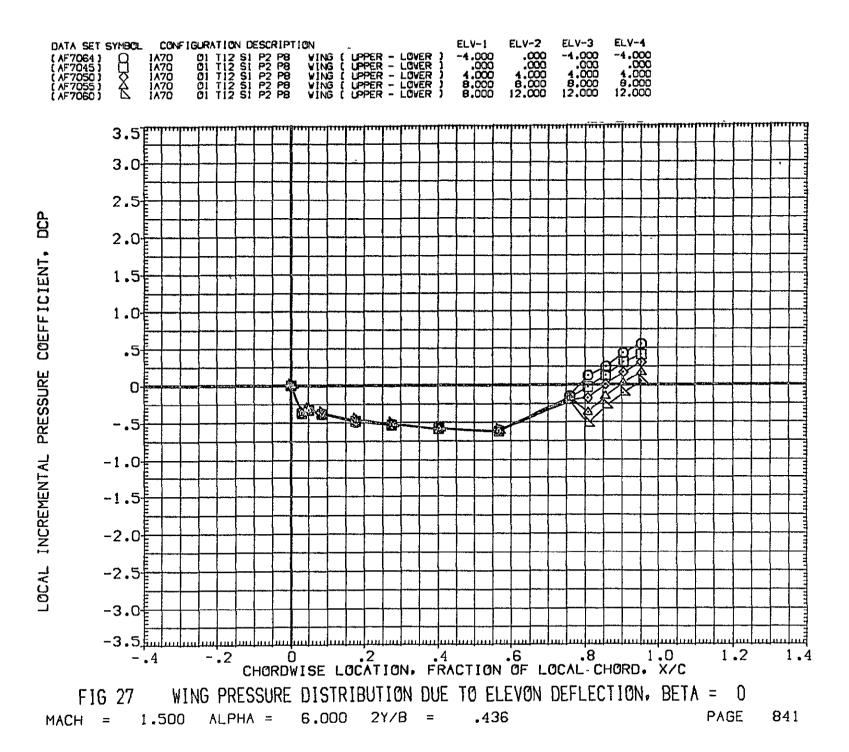


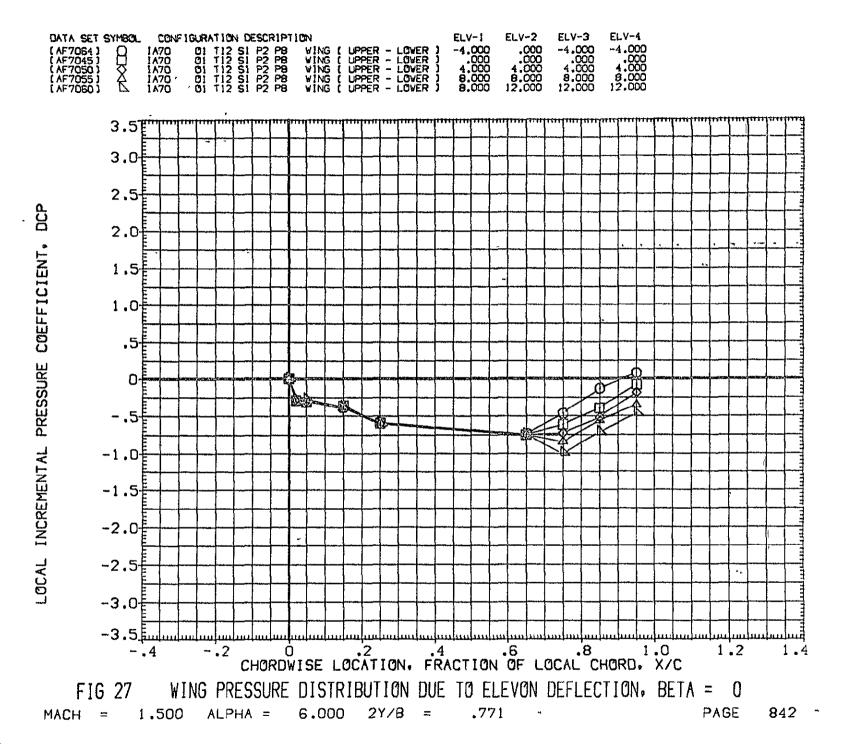


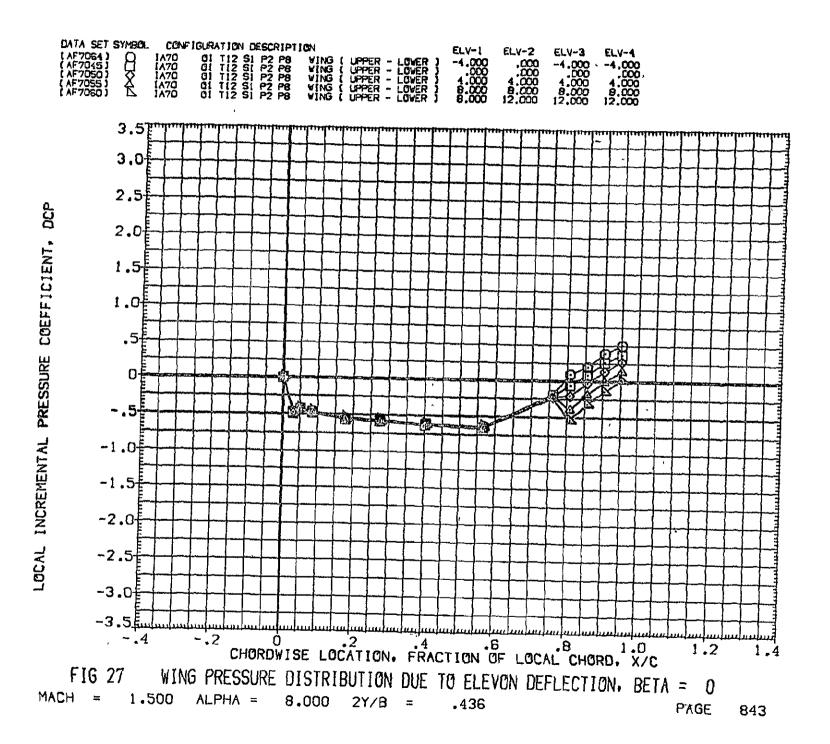


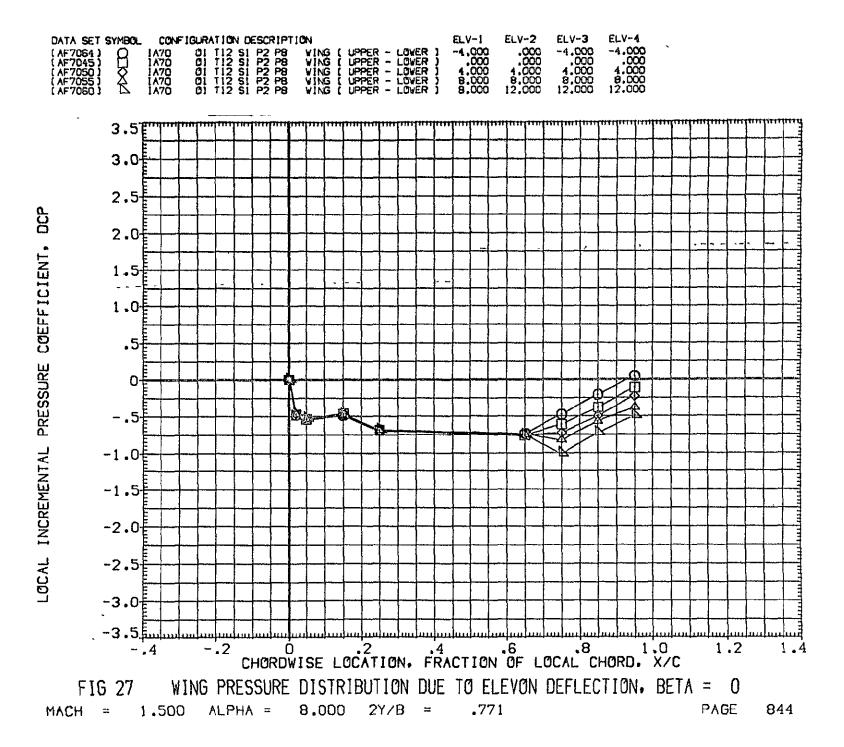


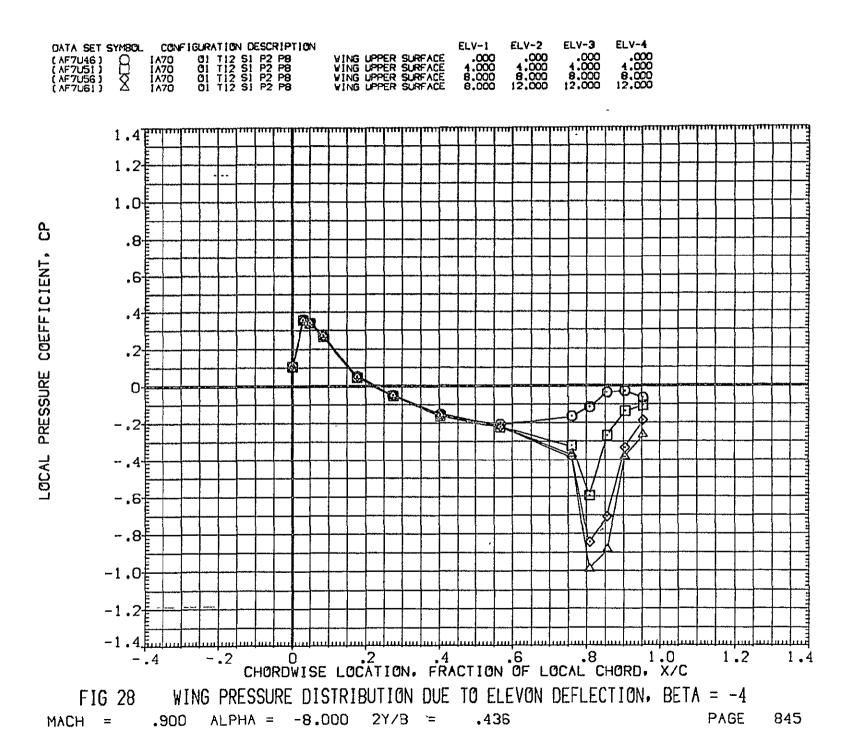


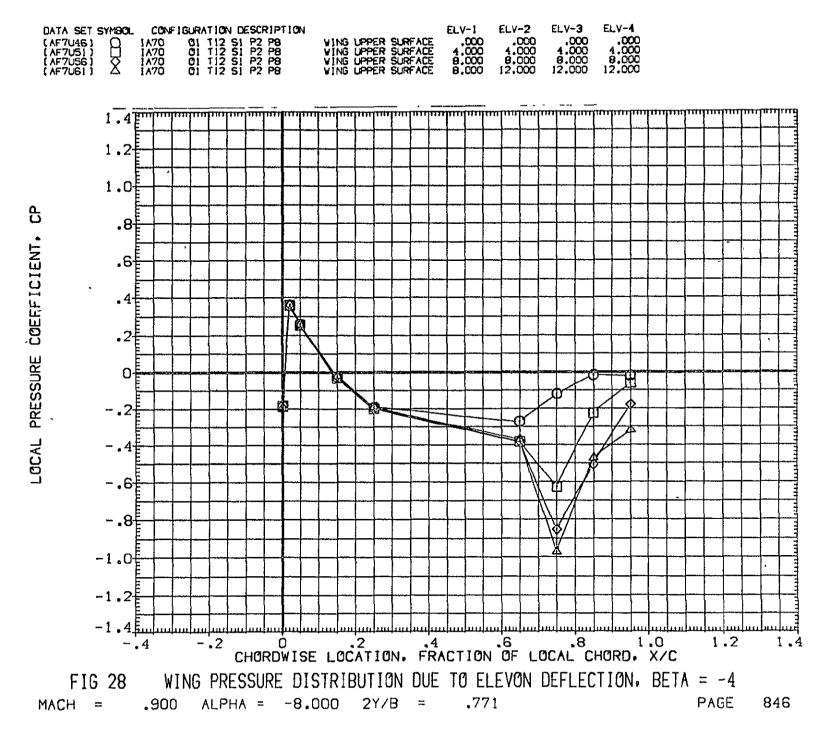


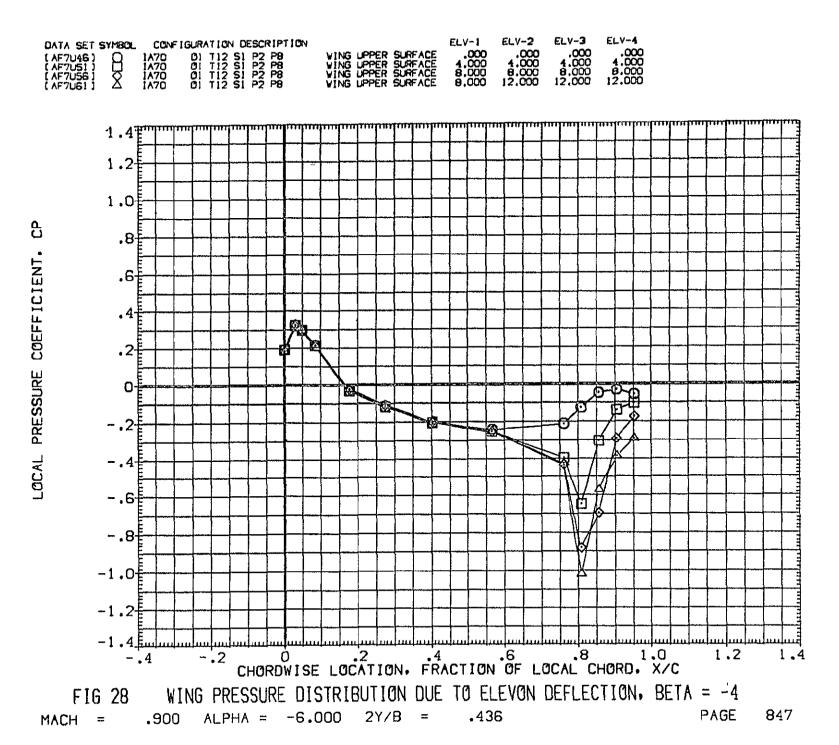




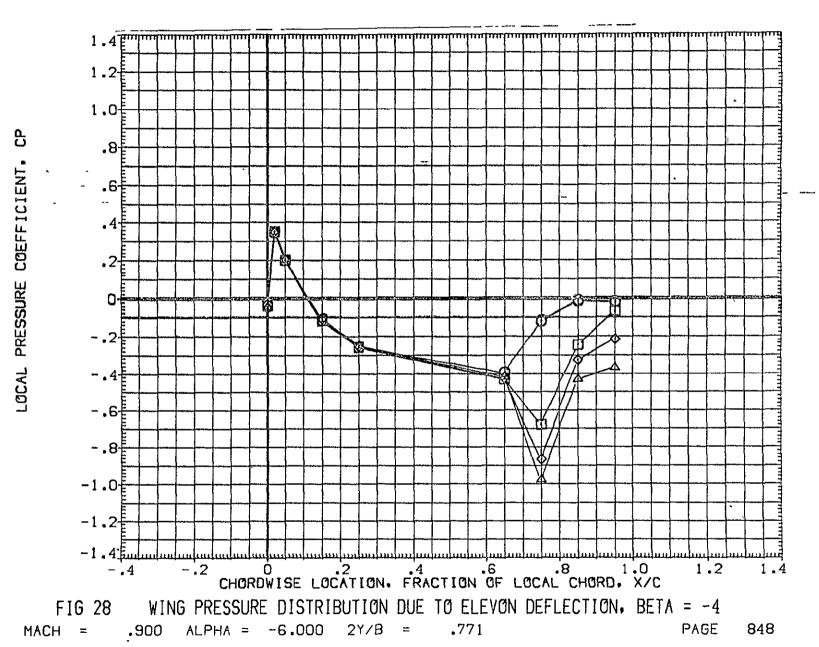


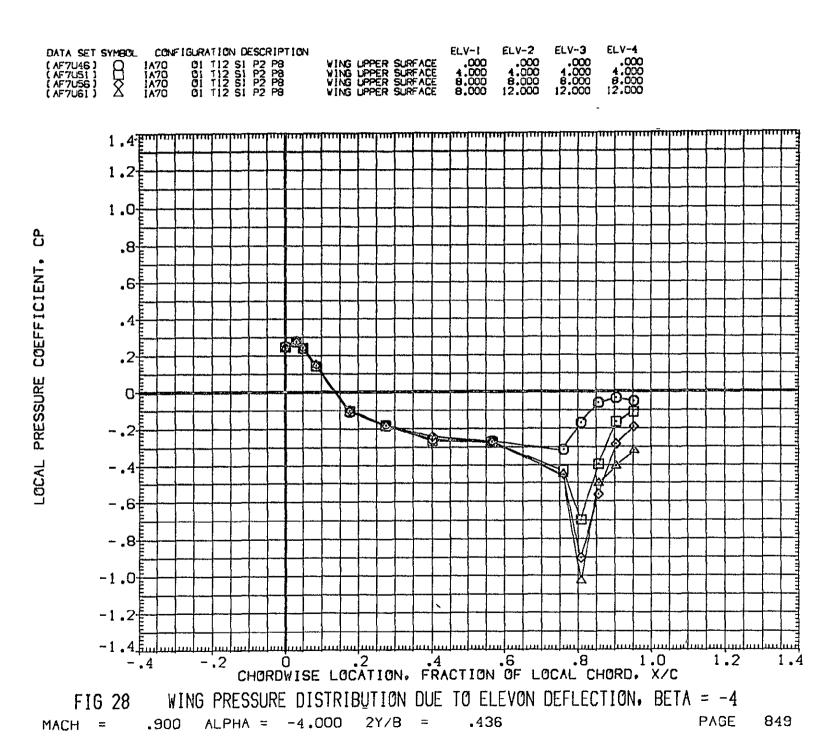


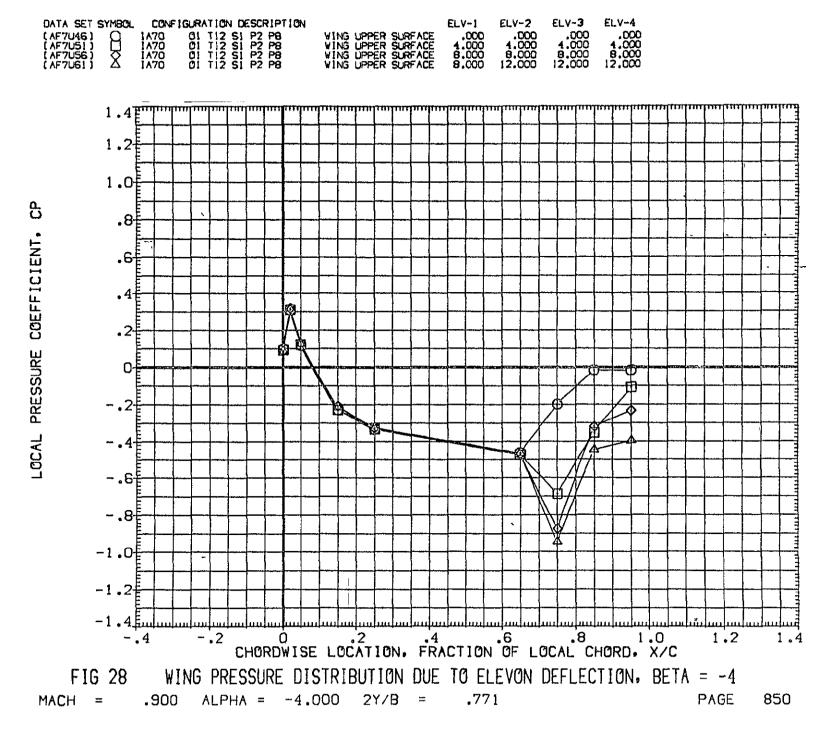


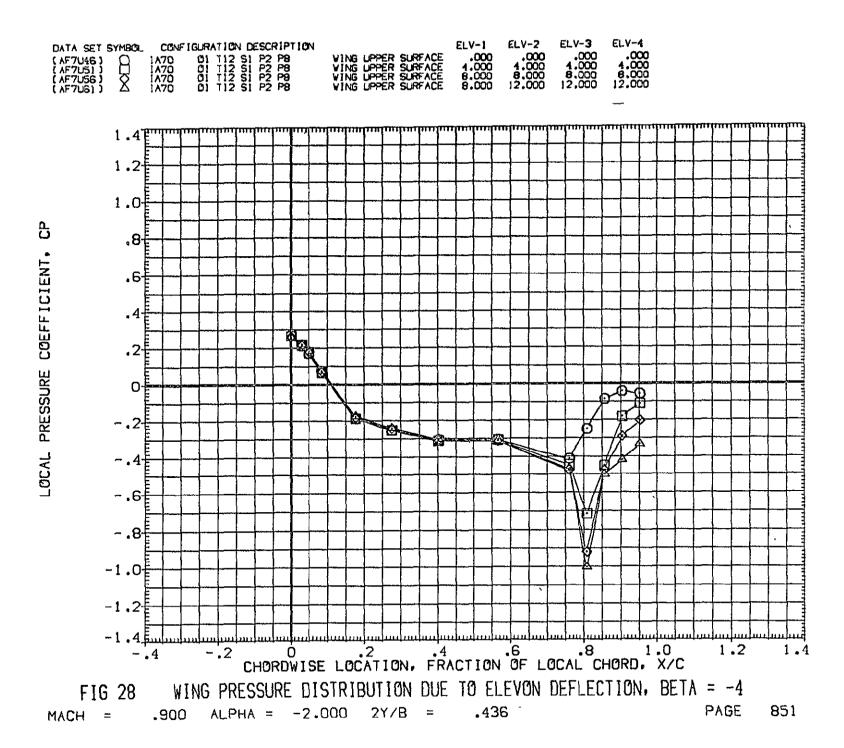


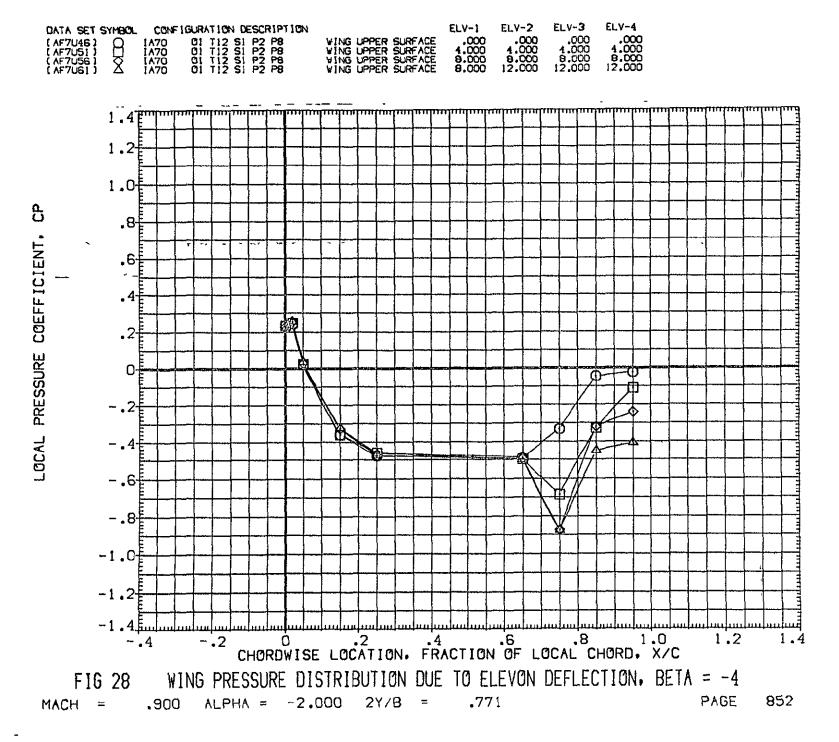


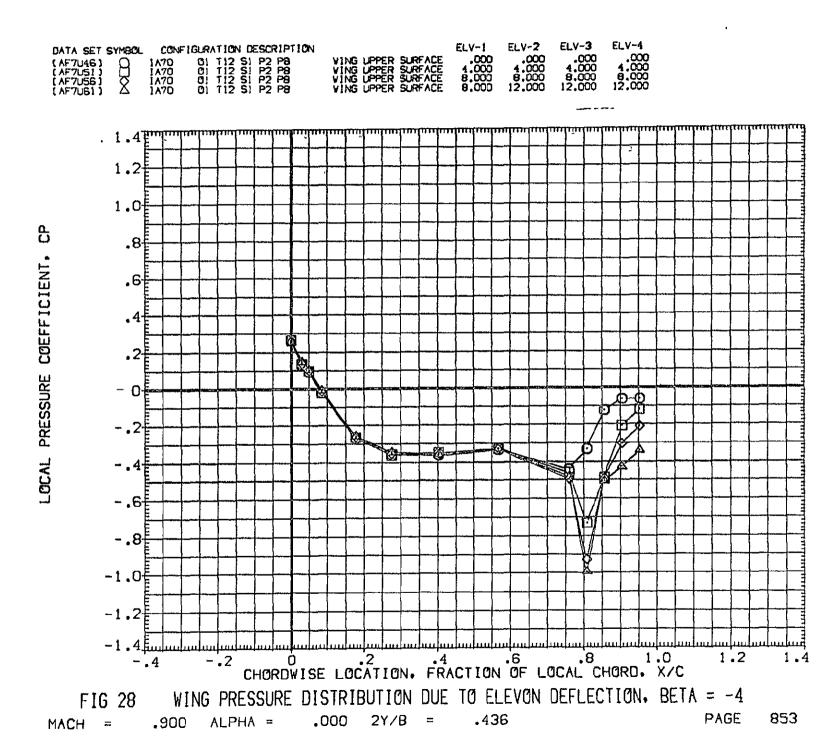


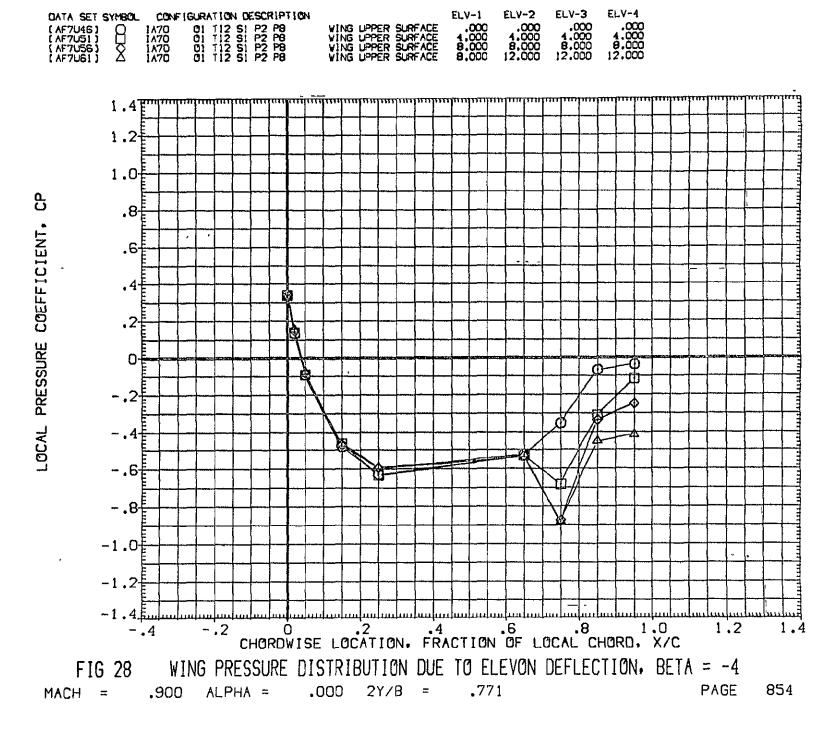


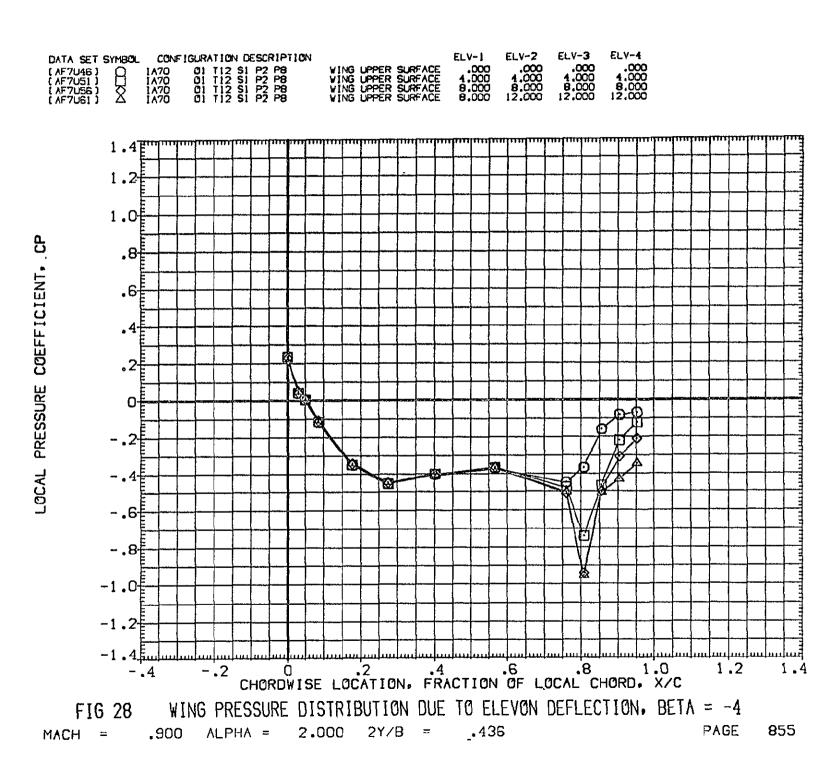


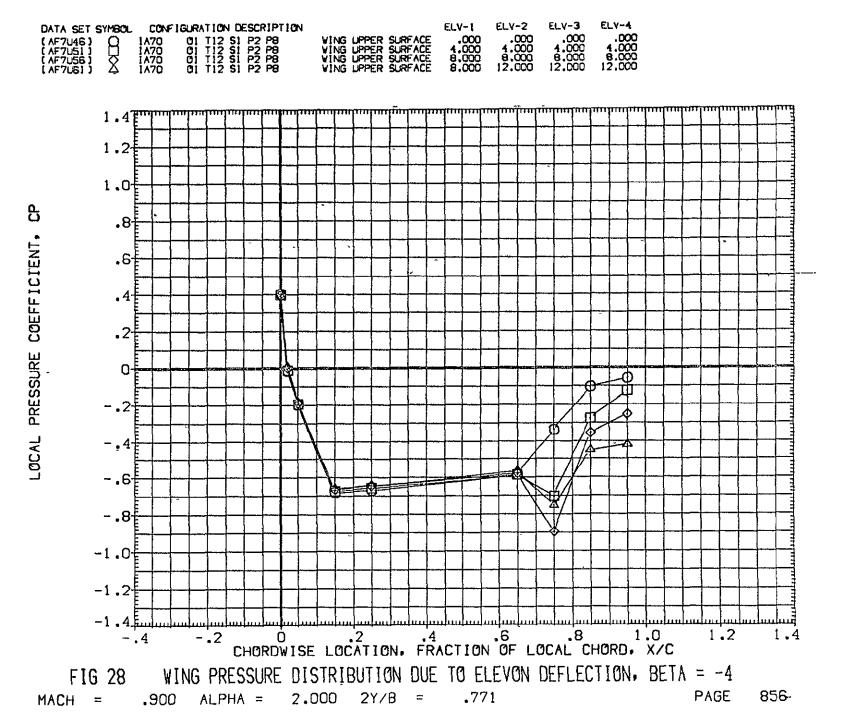


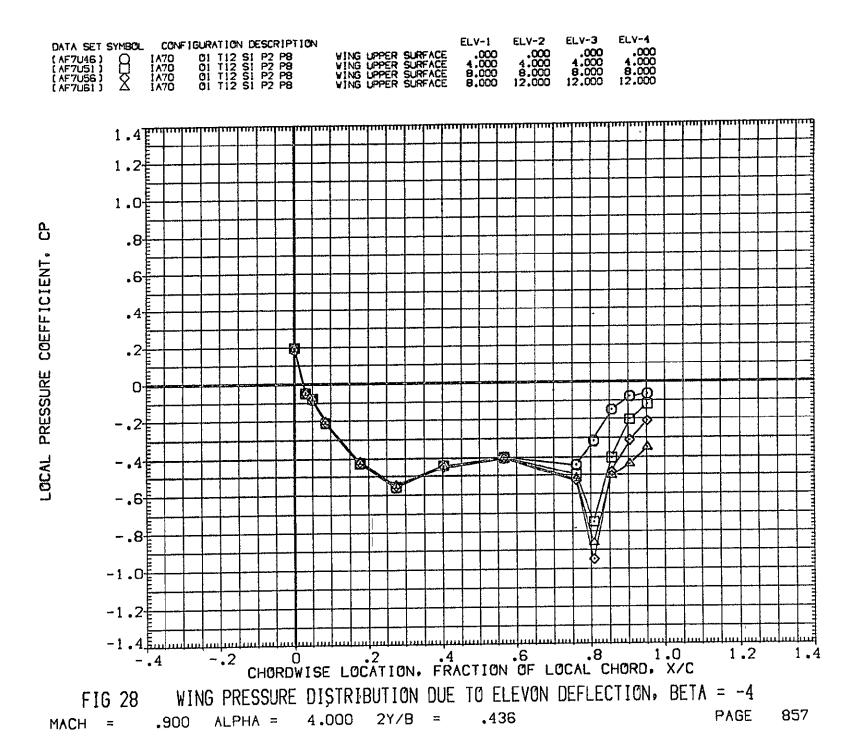


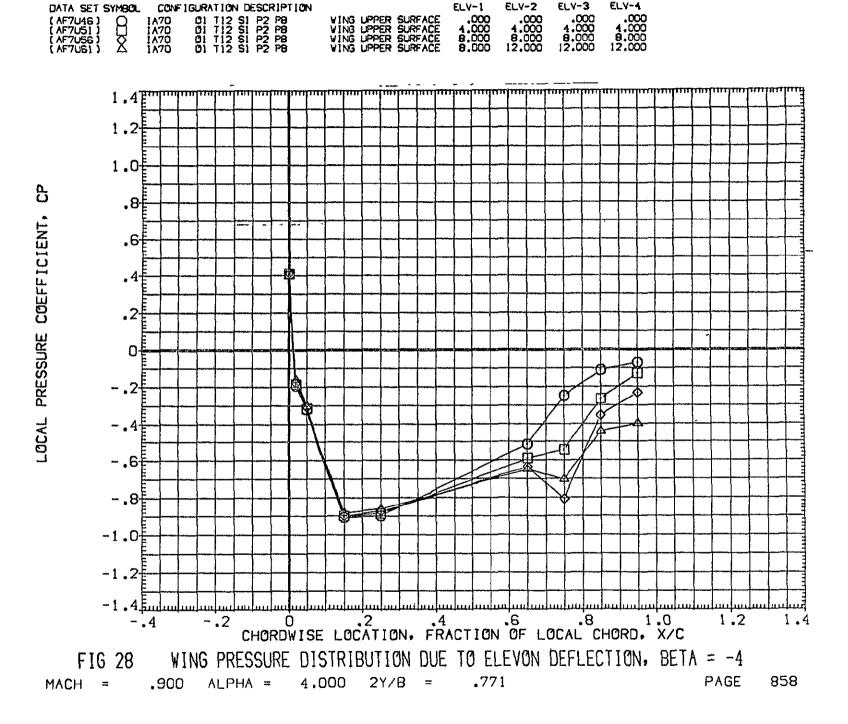


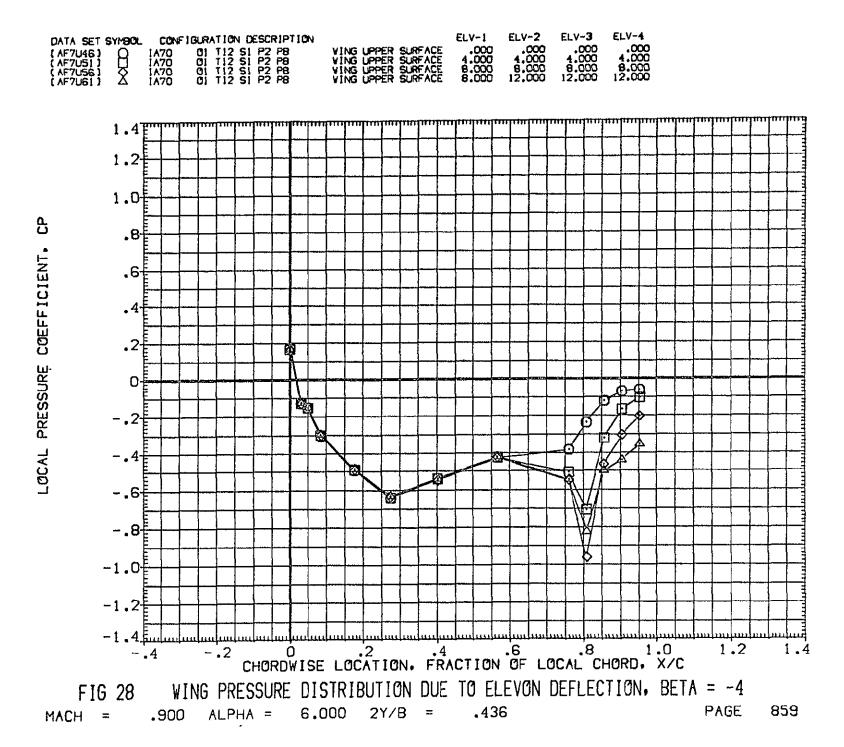


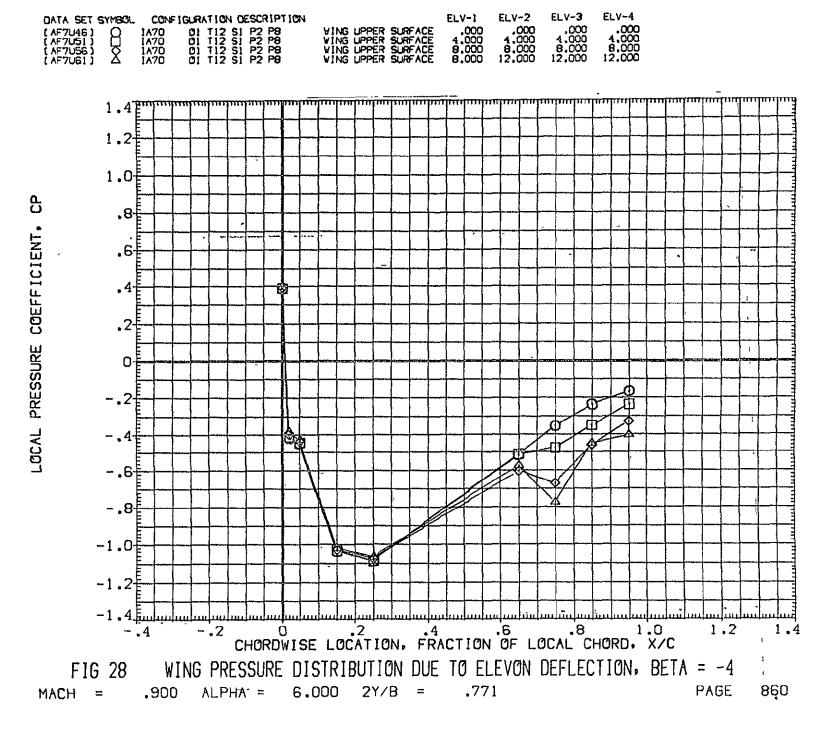


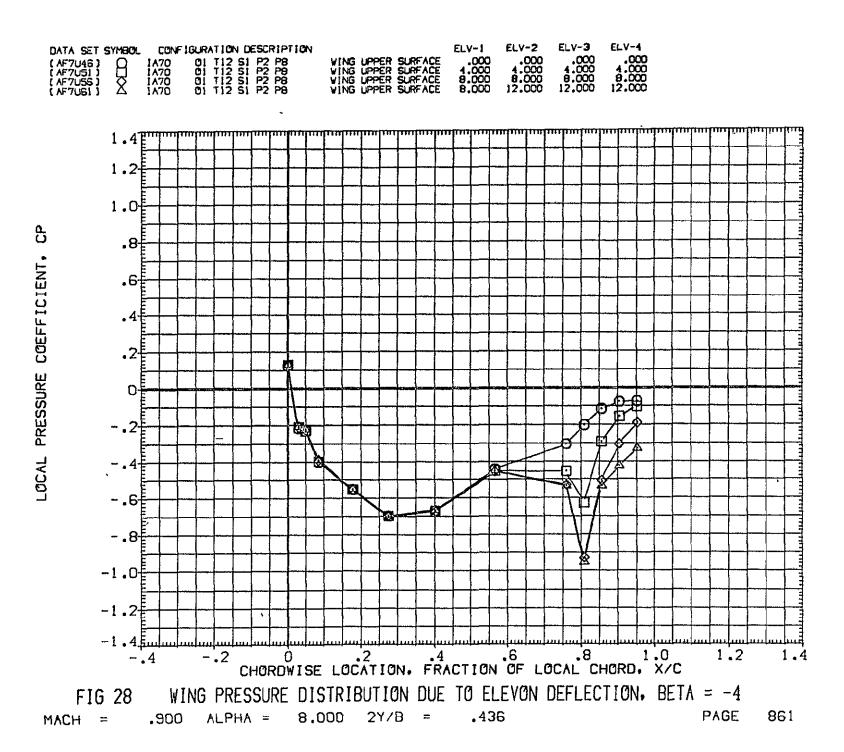


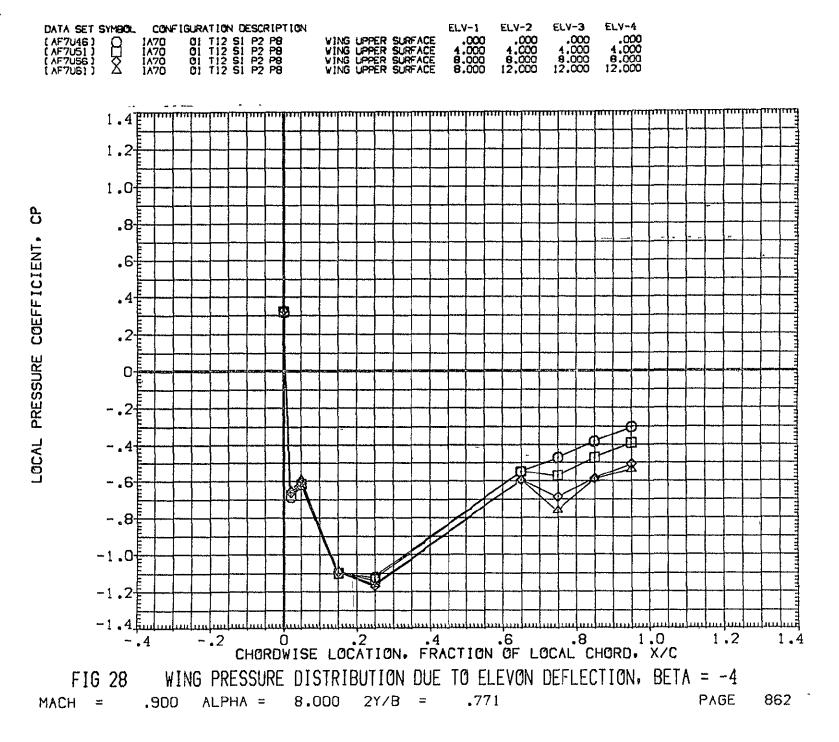


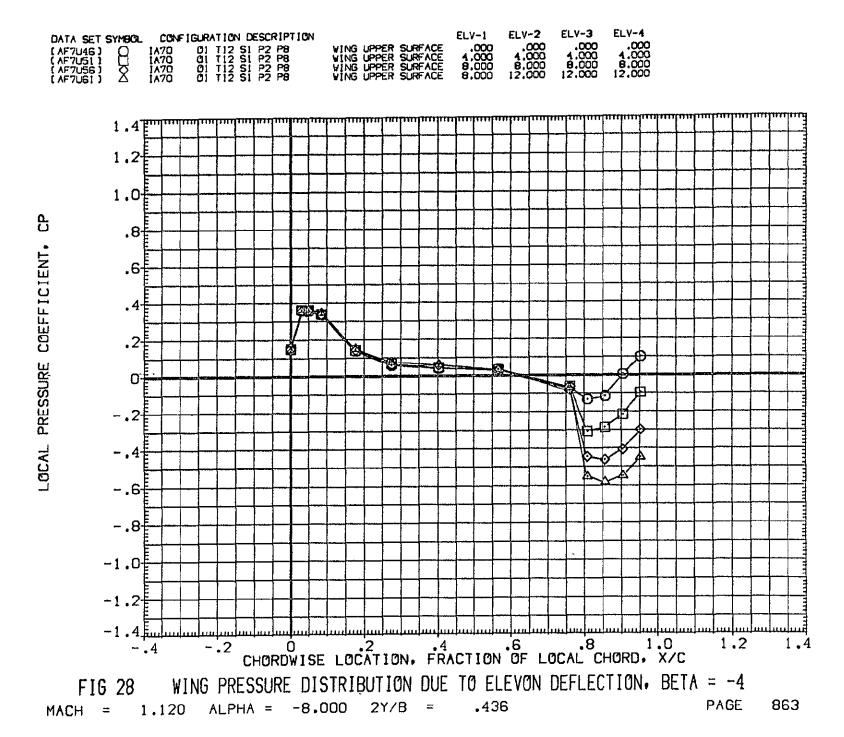


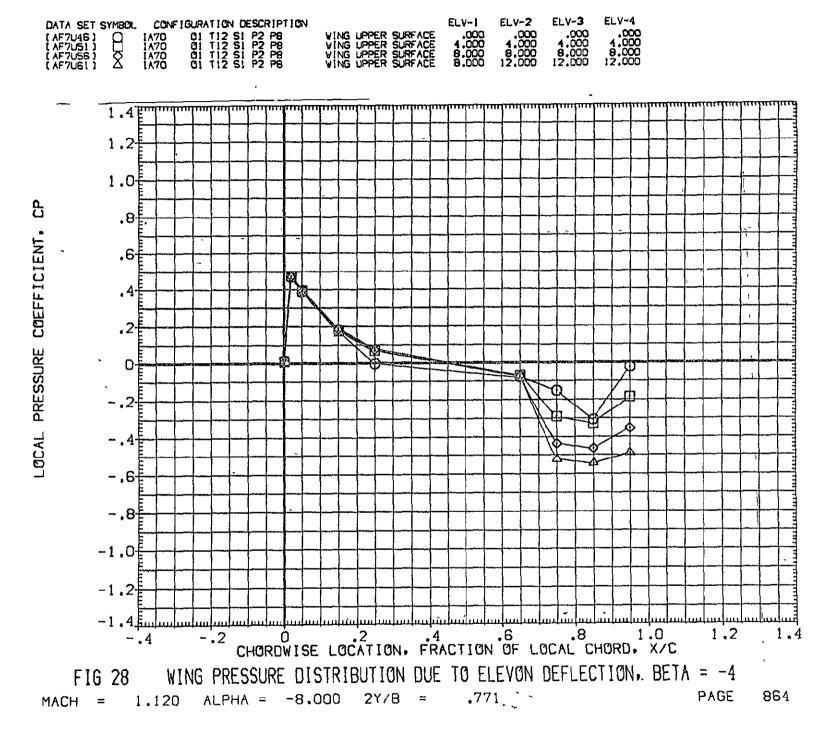


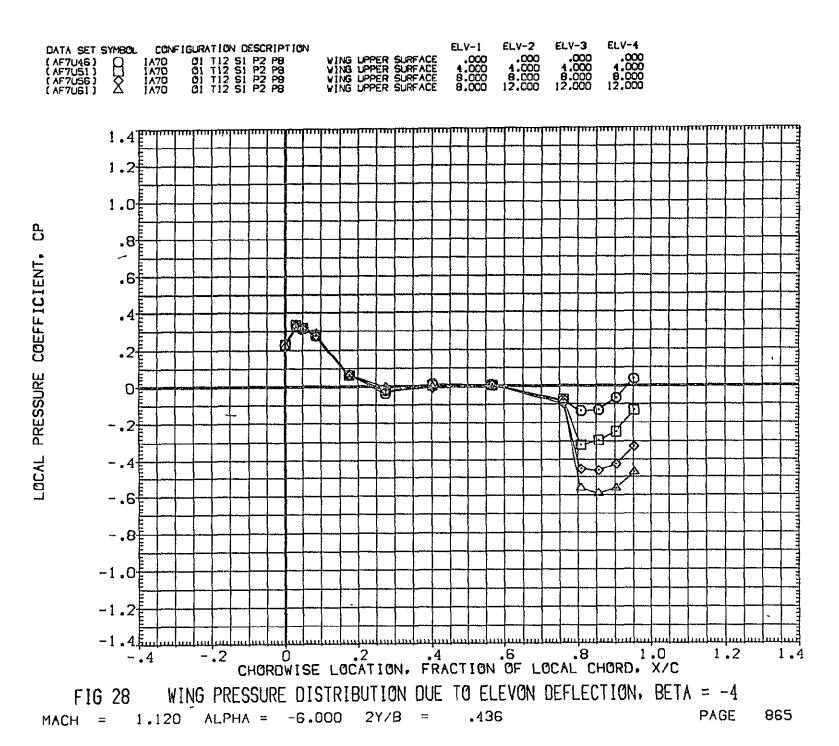




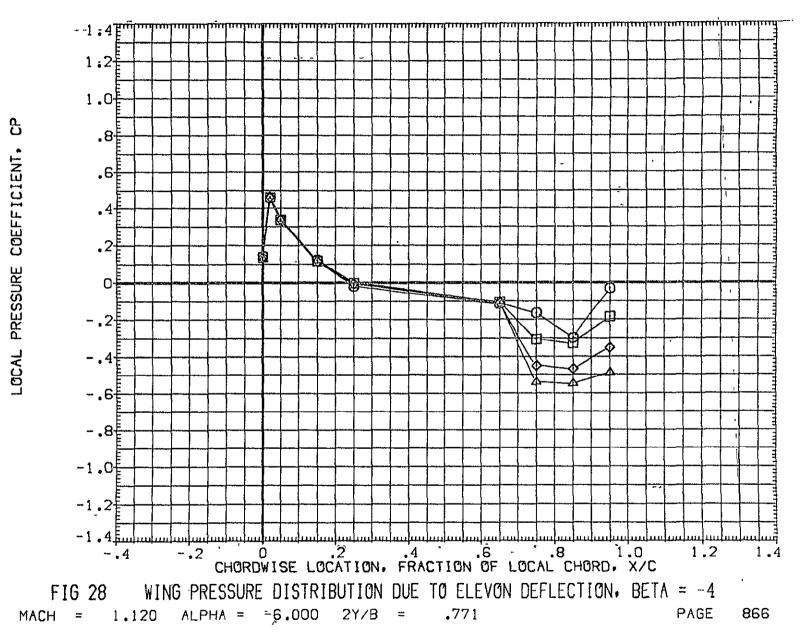


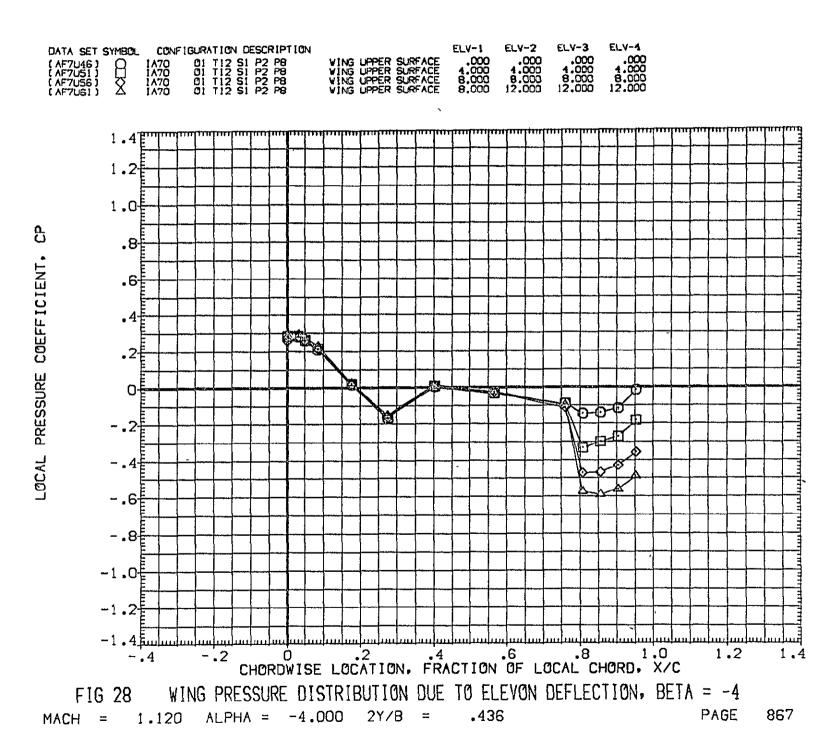


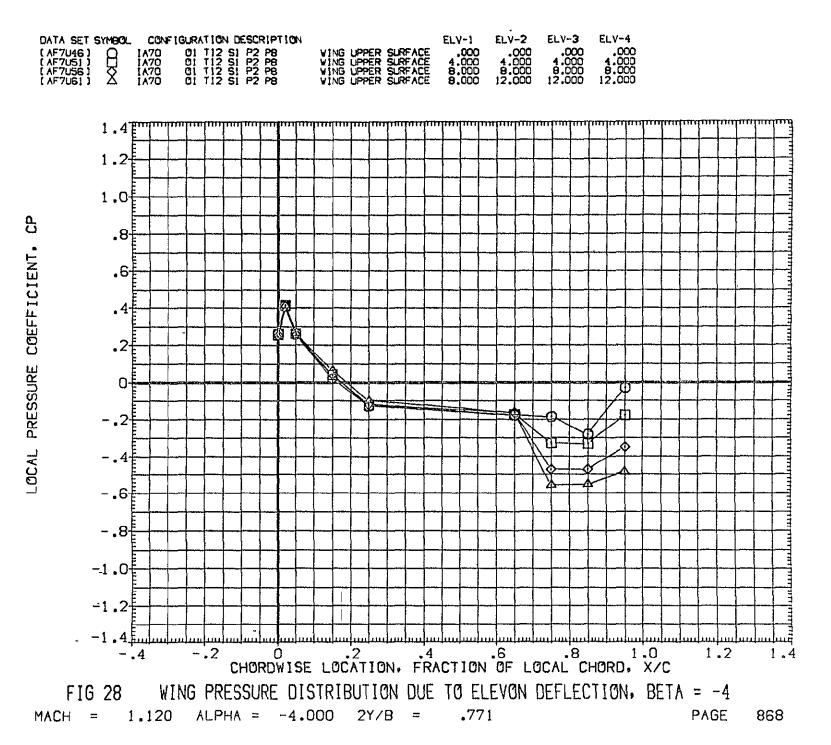


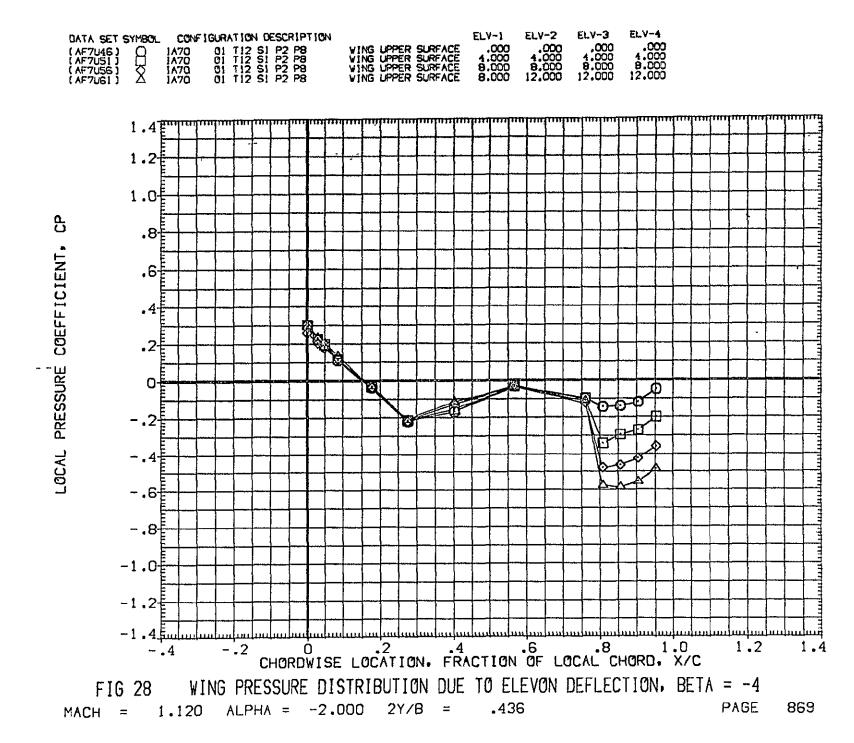


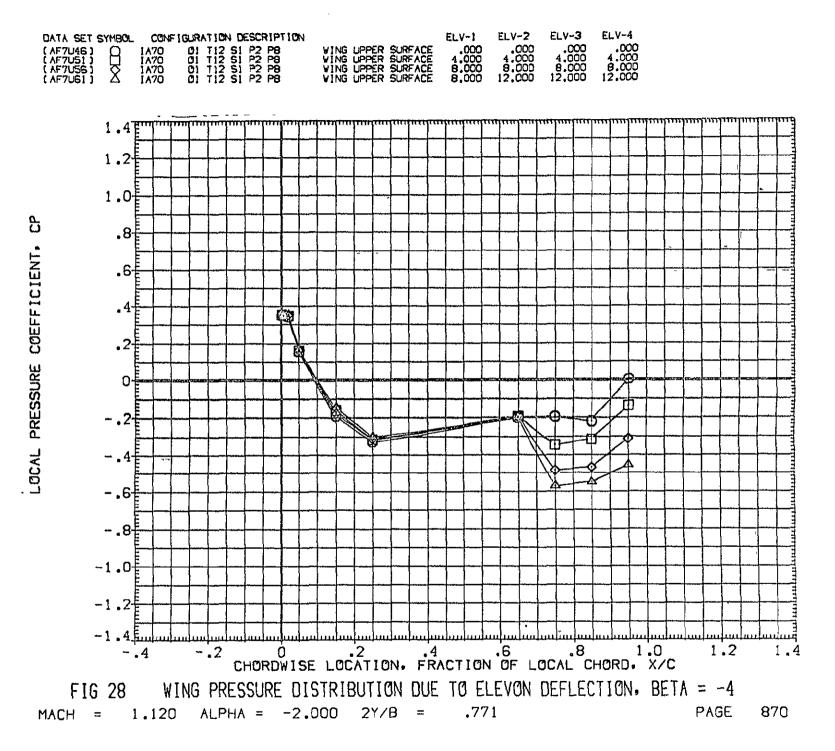


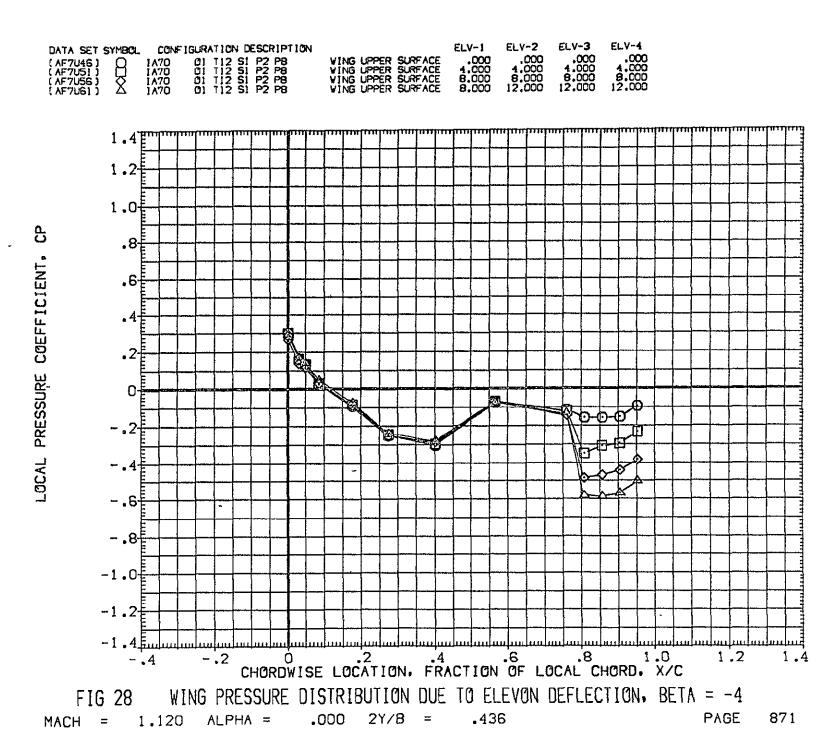


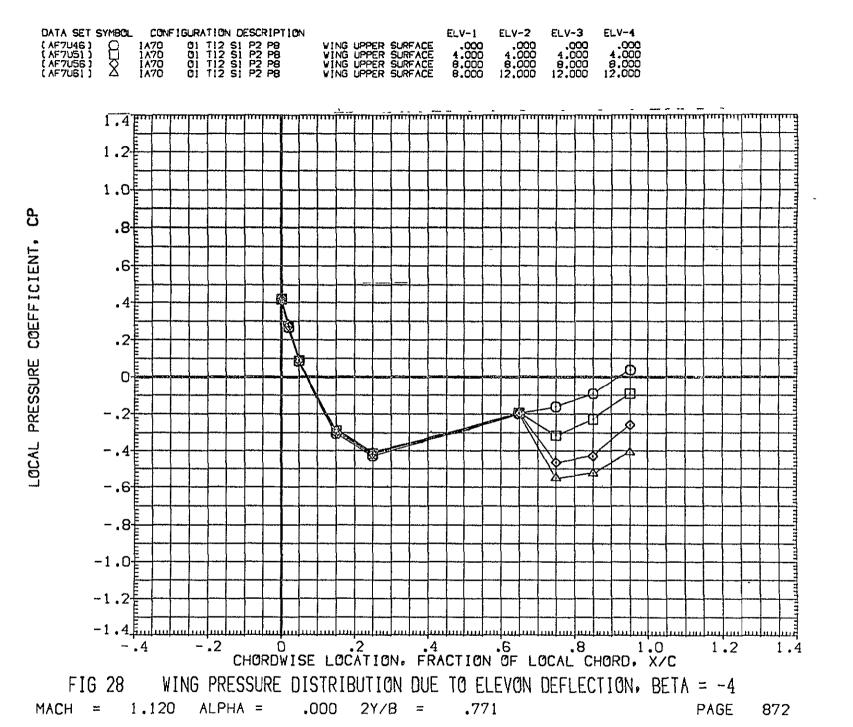


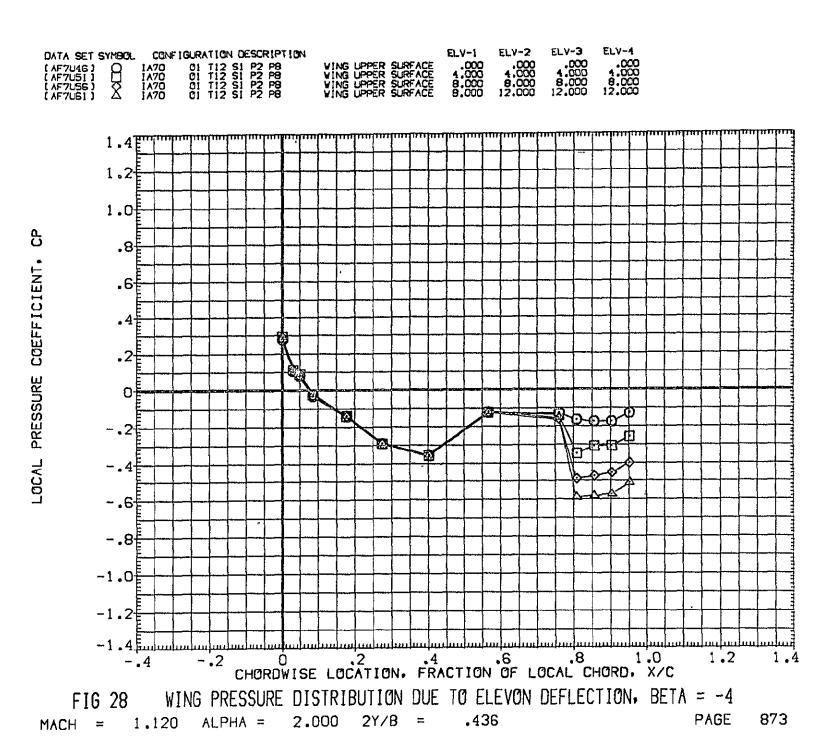


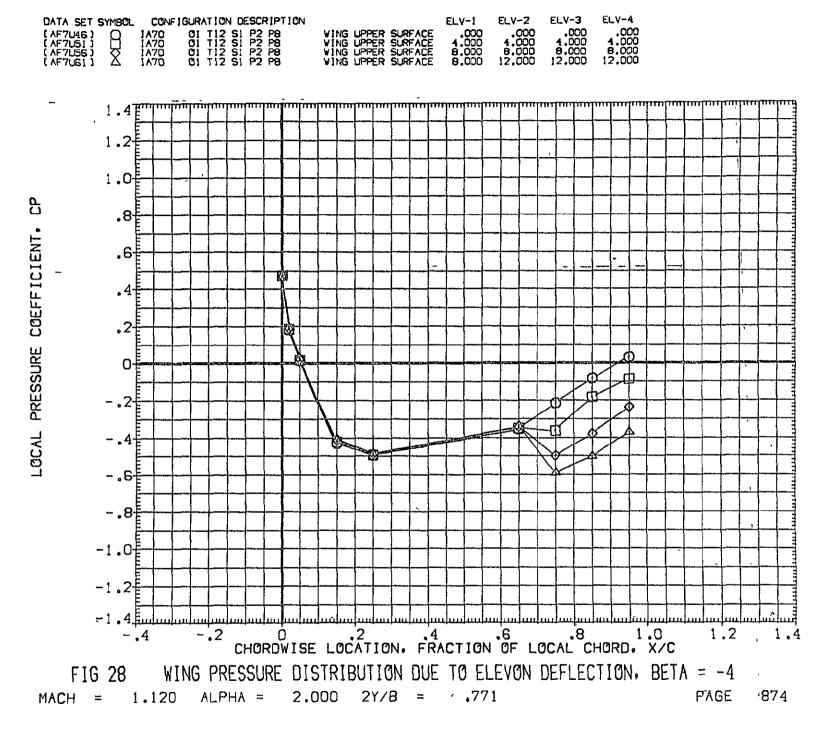


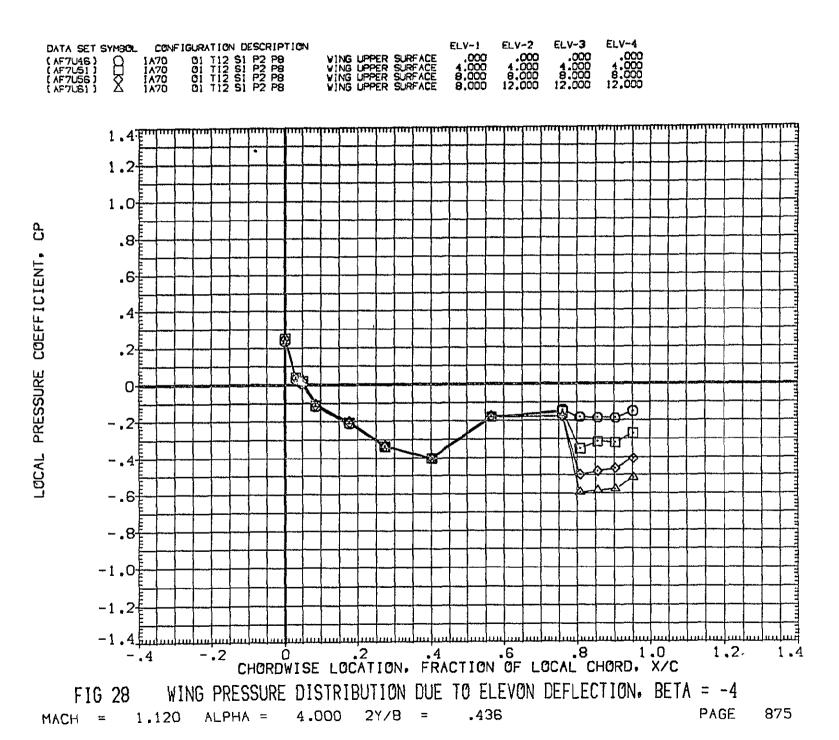












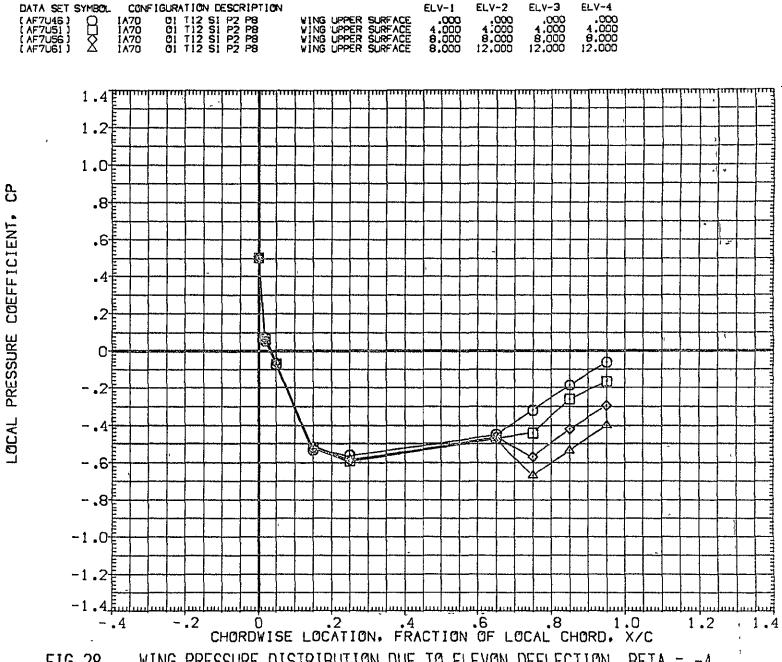
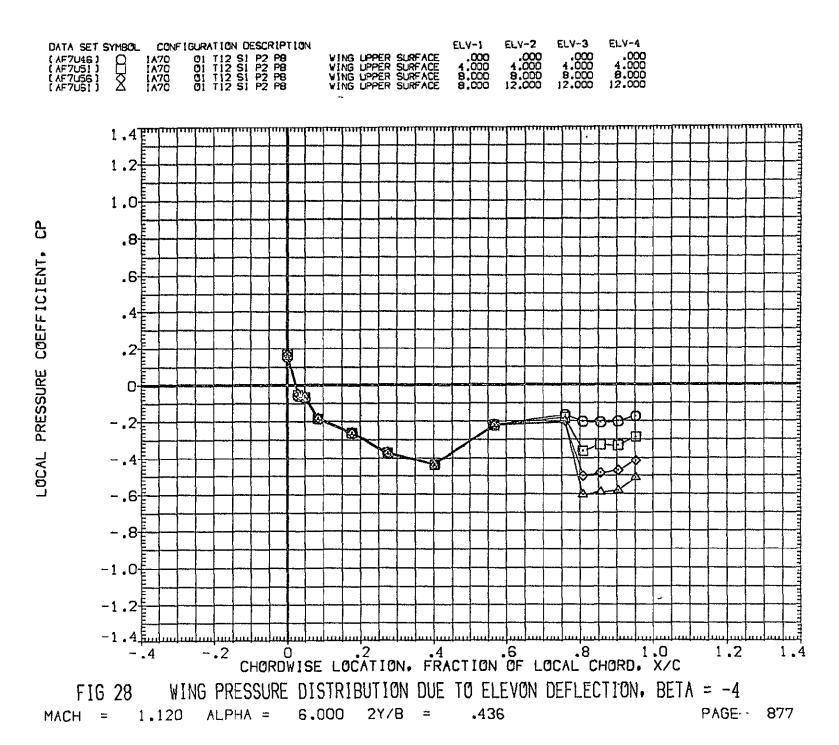
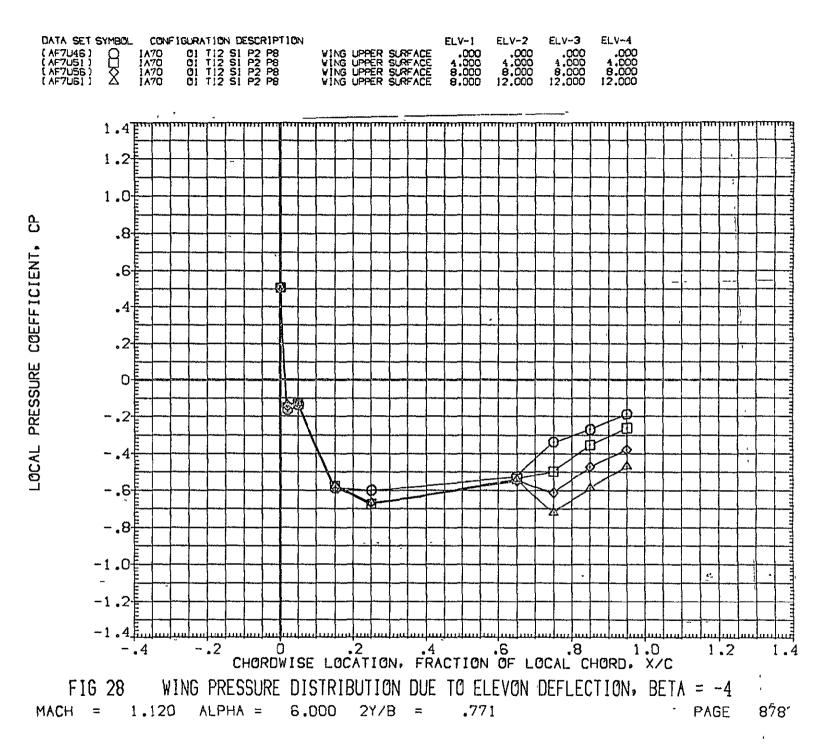
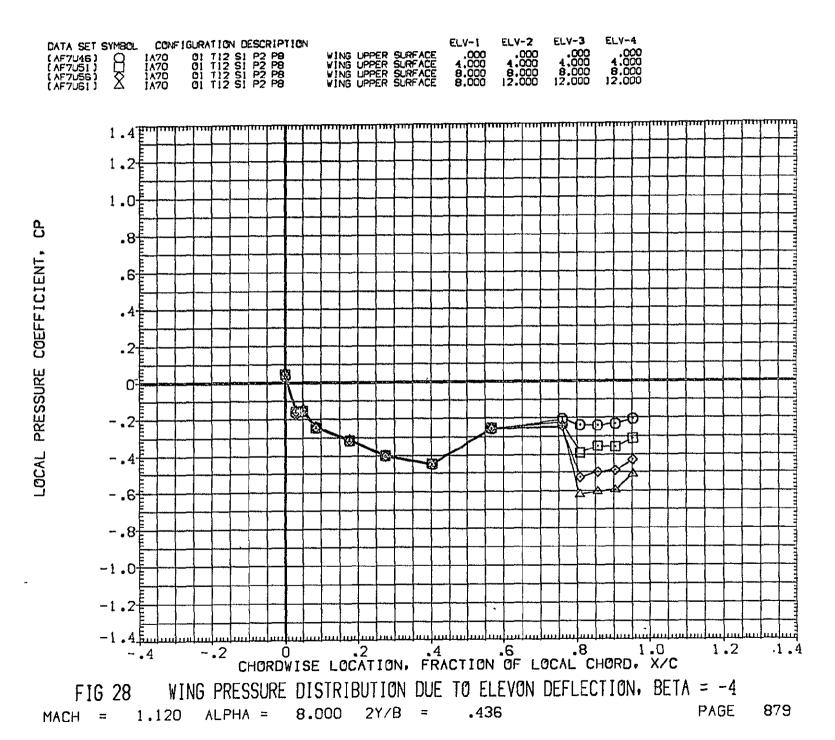
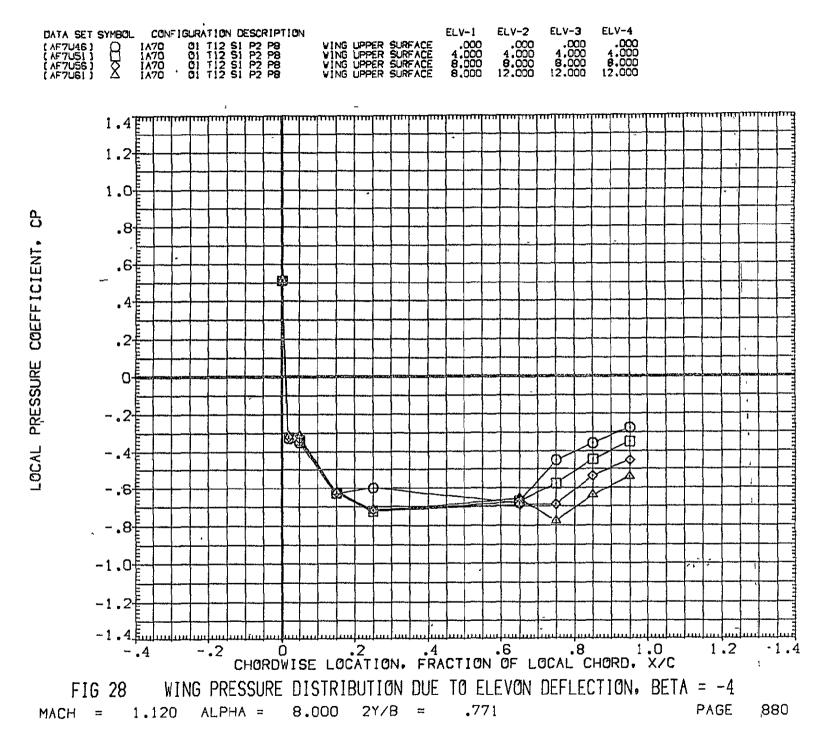


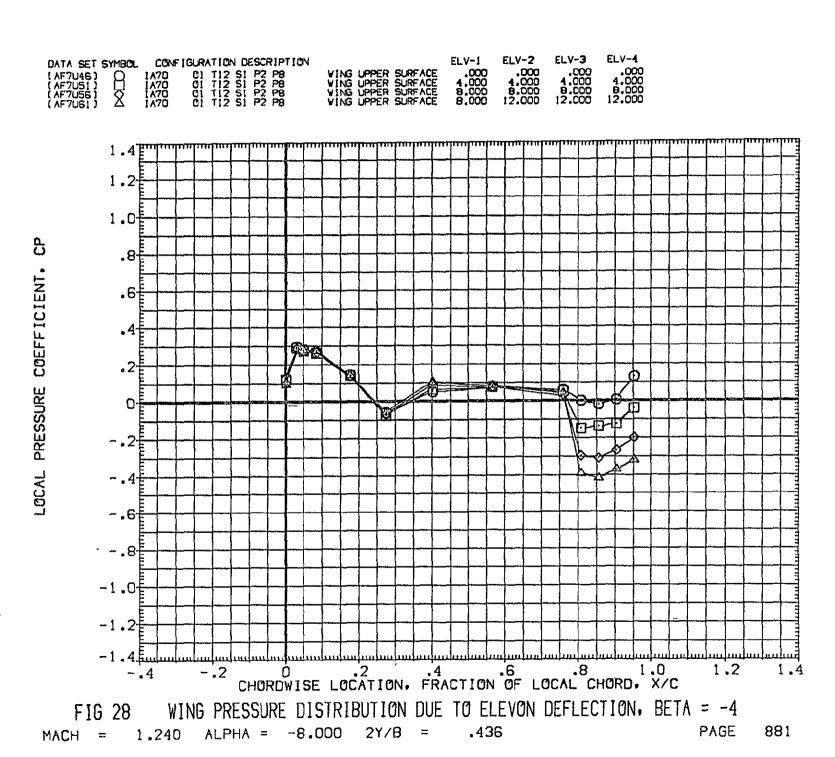
FIG 28 WING PRESSURE DISTRIBUTION DUE TO ELEVON DEFLECTION, BETA = -4
MACH = 1.120 ALPHA = 4.000 2Y/B = .771 PAGE 876

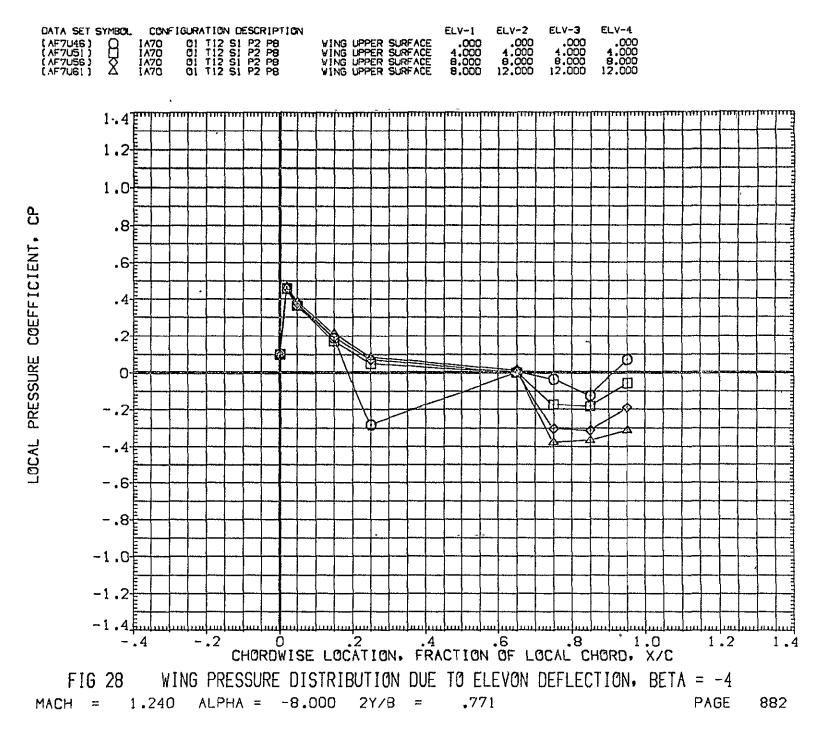


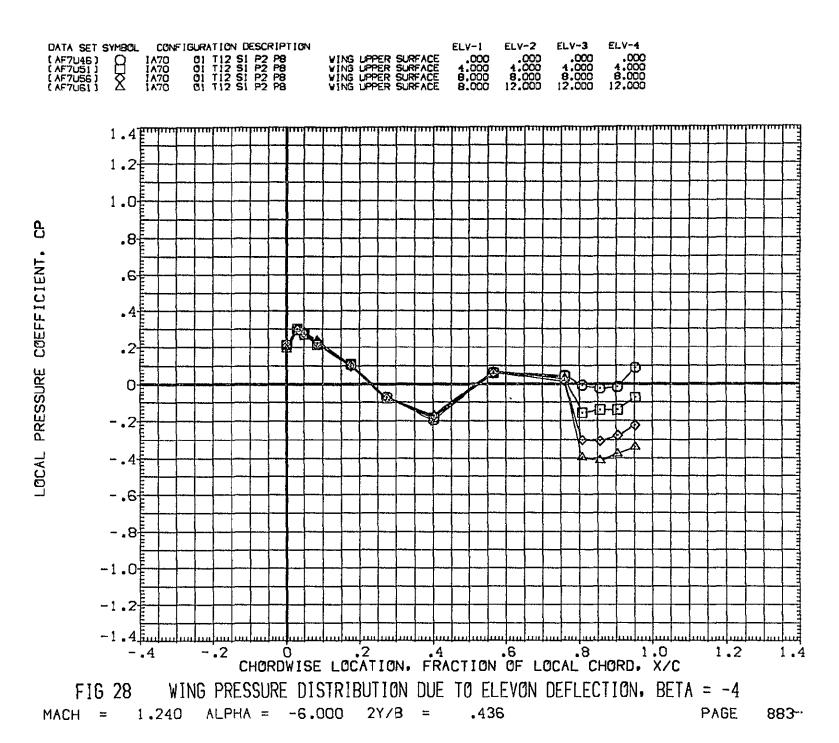


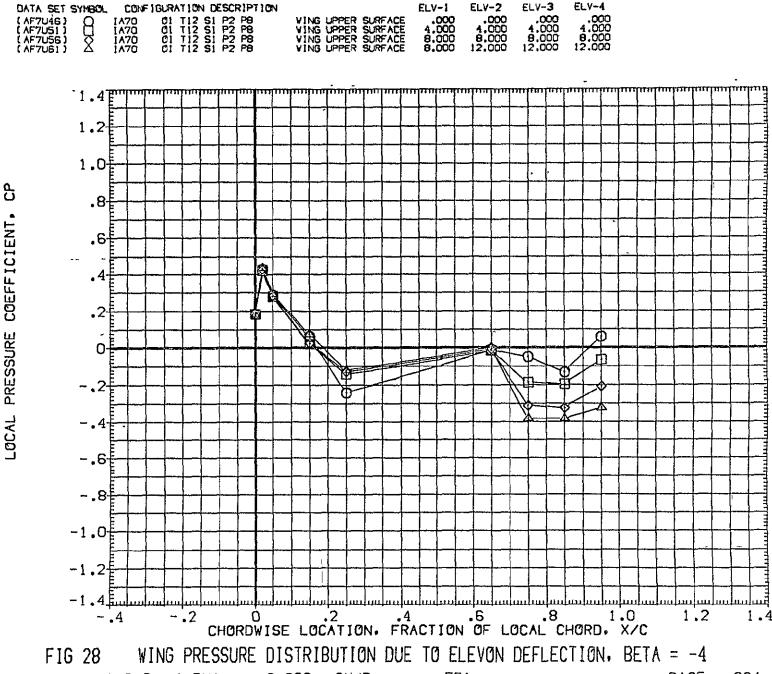




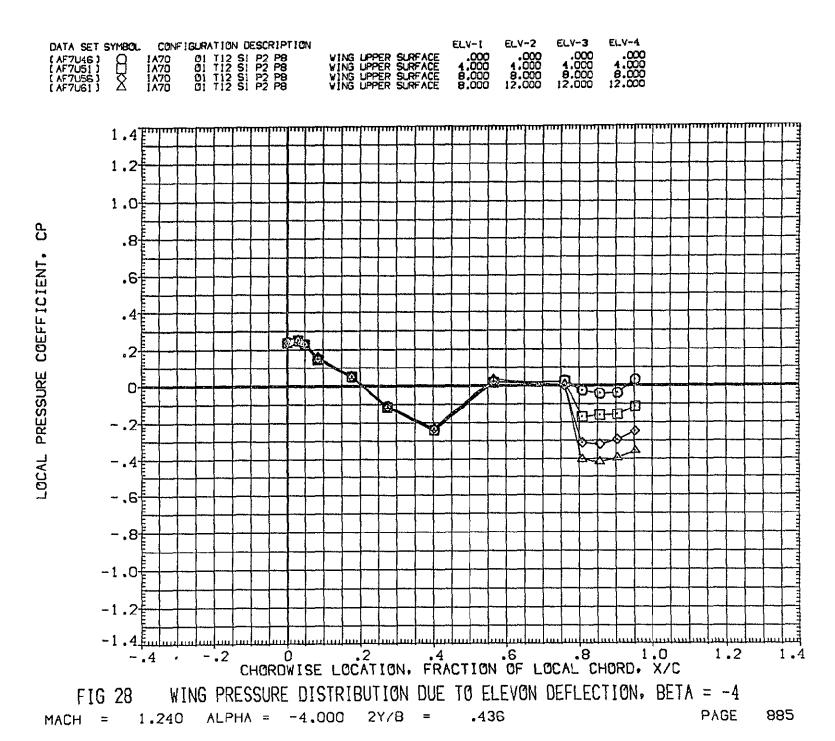


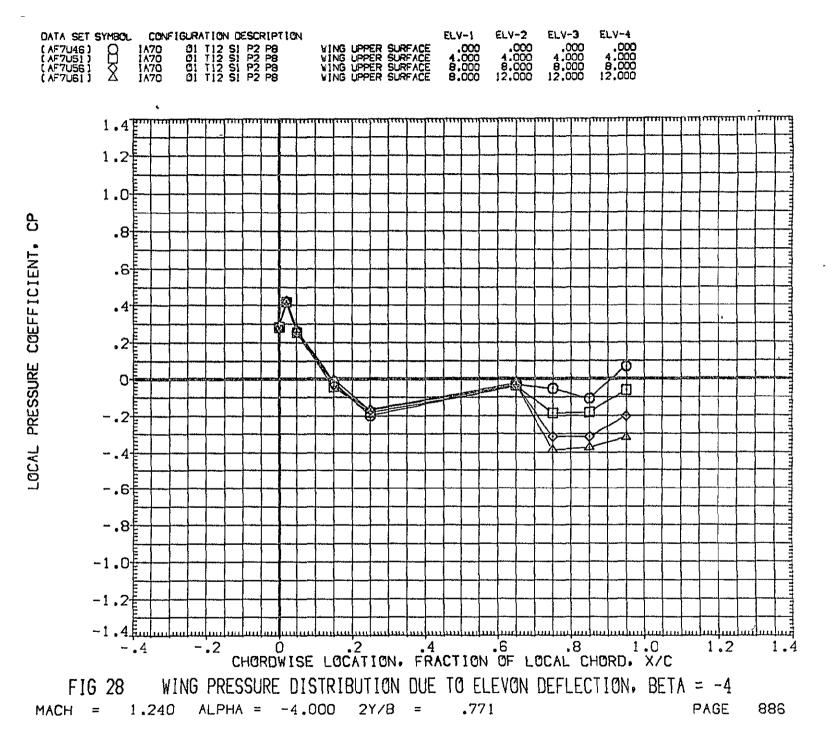


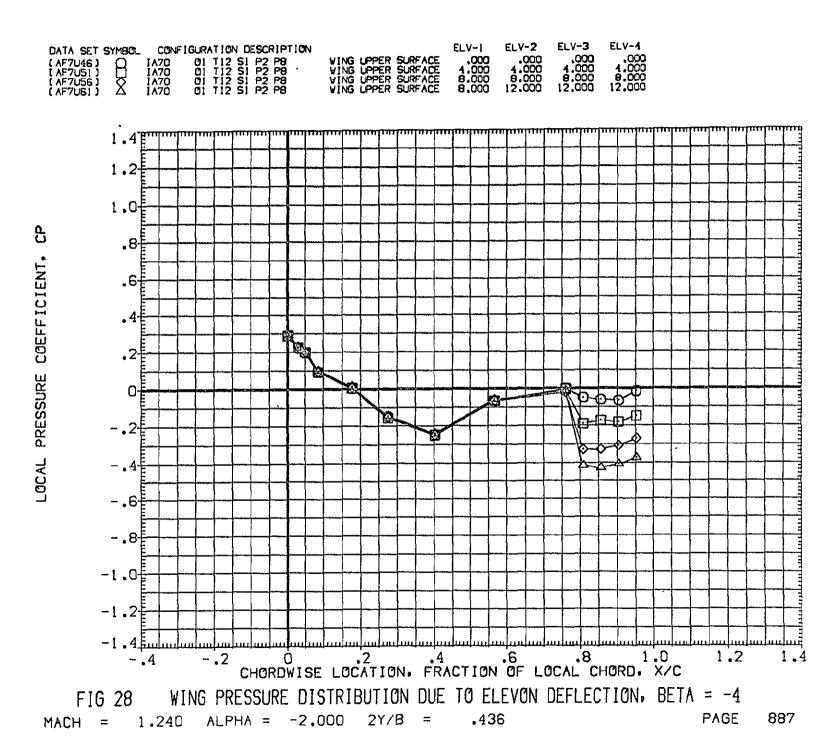


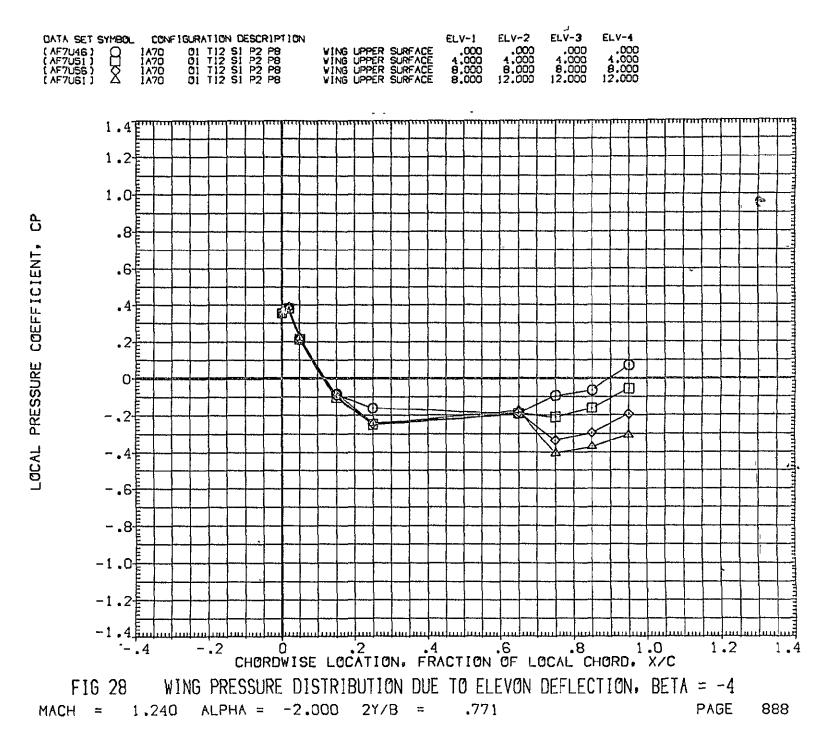


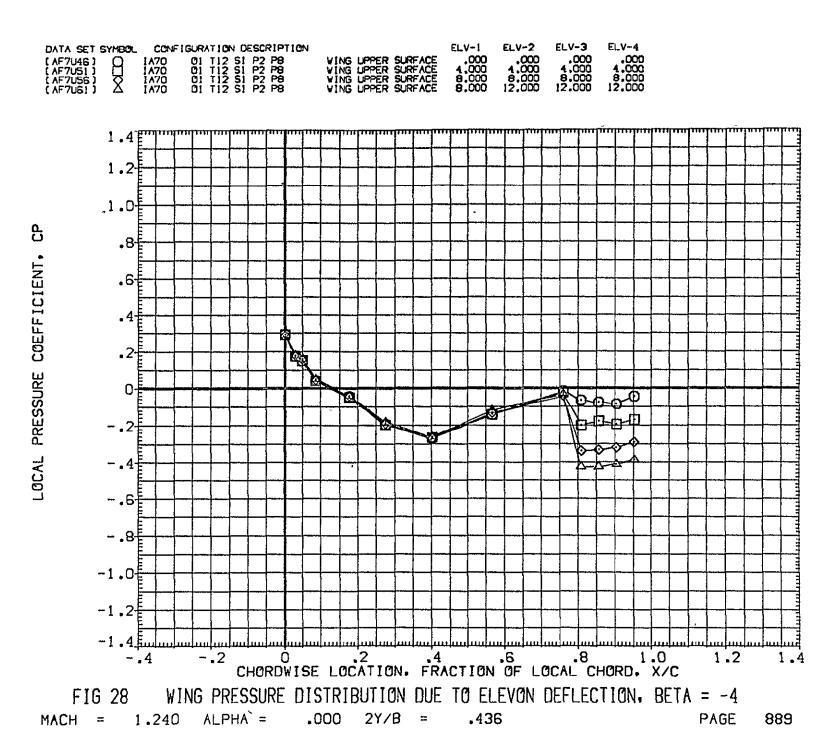
MACH = 1.240 ALPHA = -6.000 2Y/B = .771PAGE 884

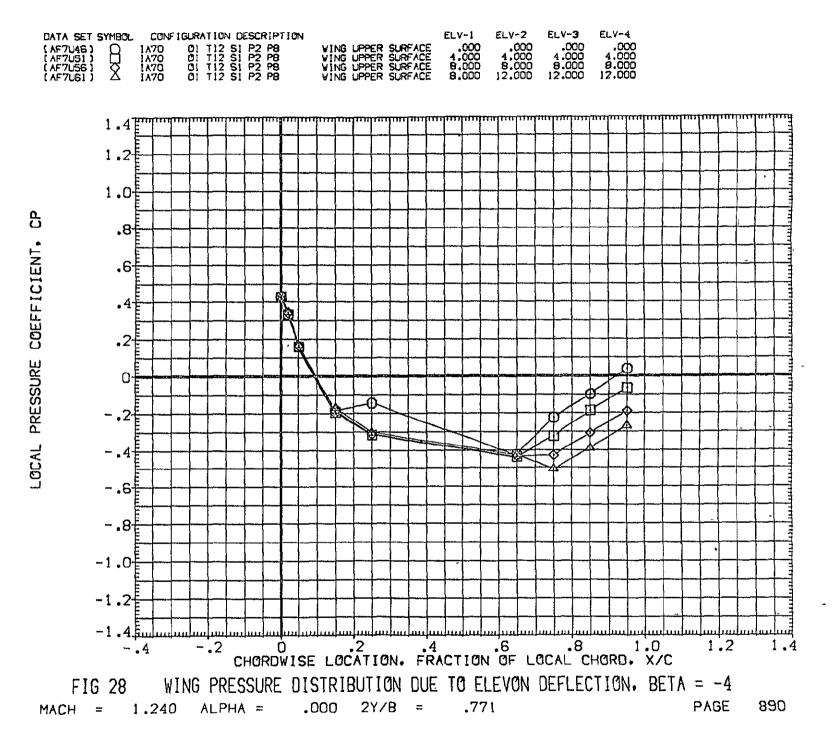


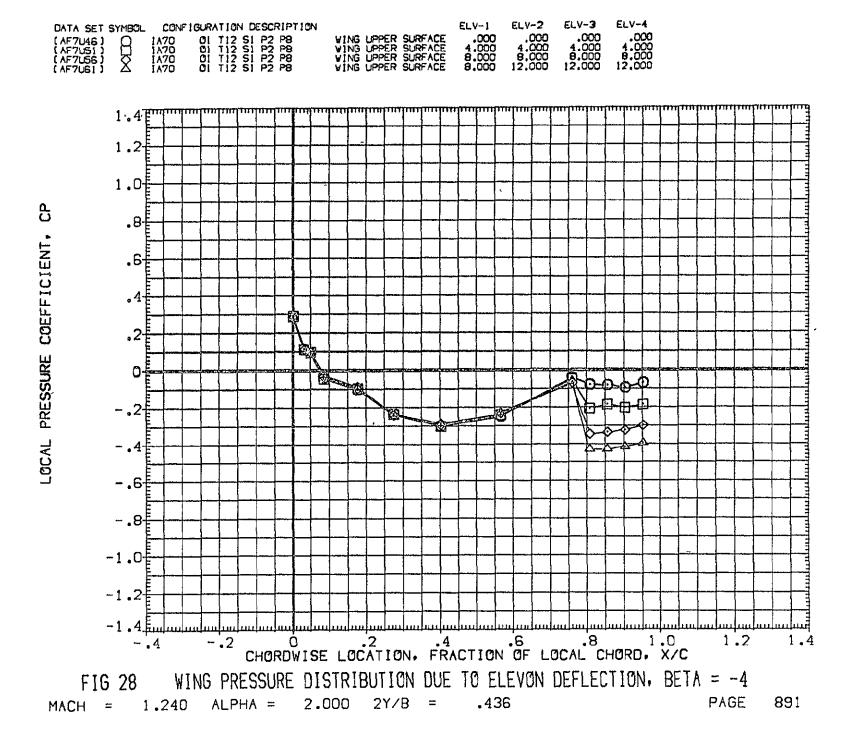


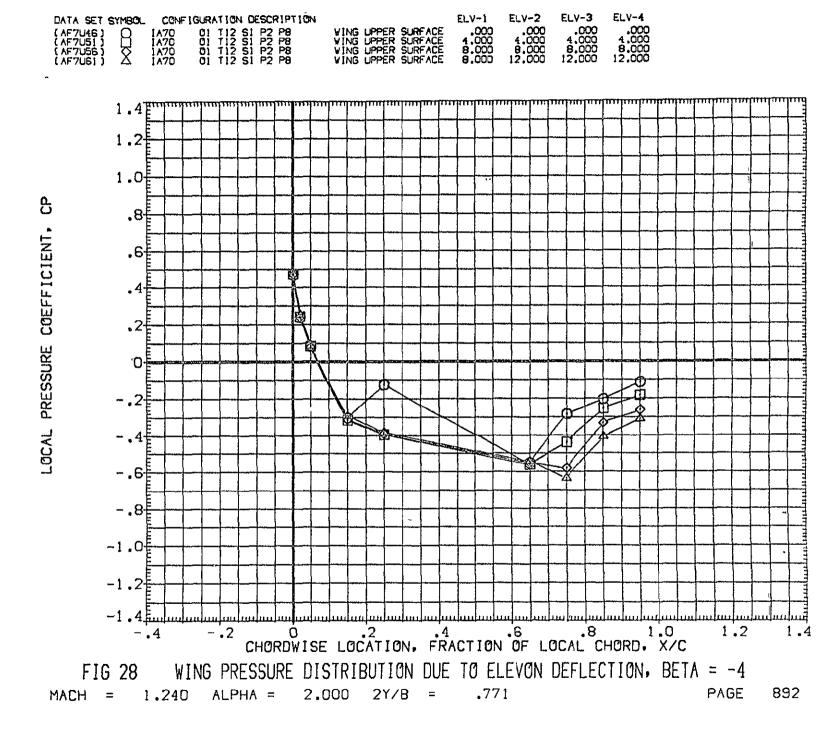


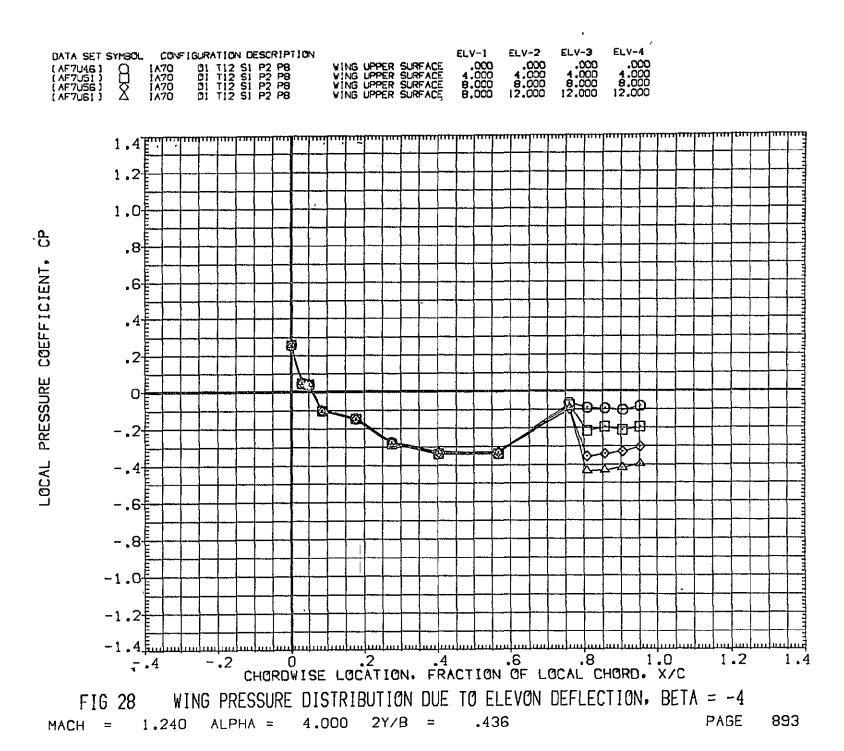


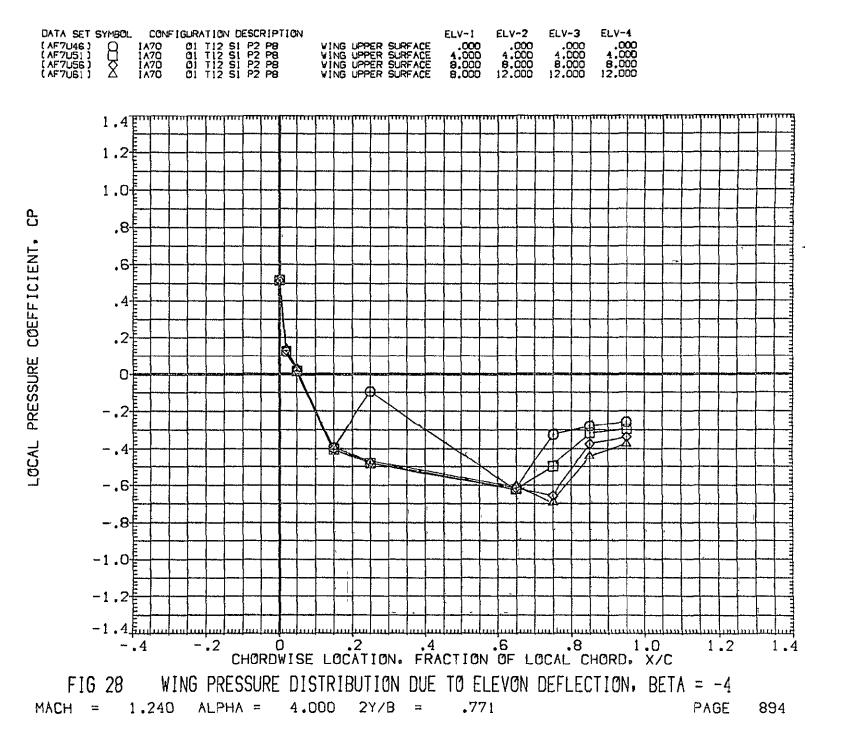


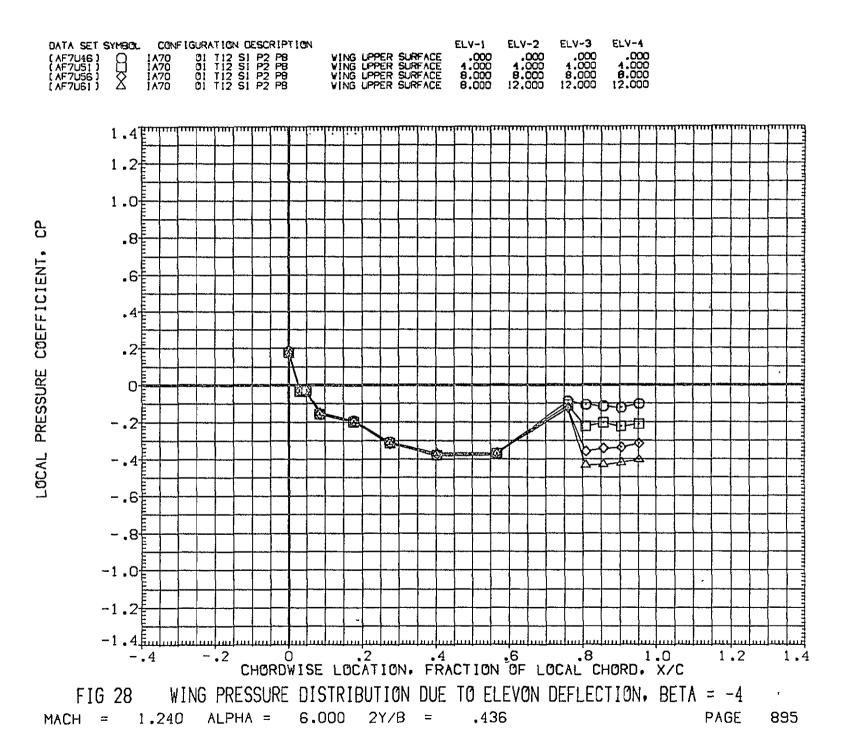


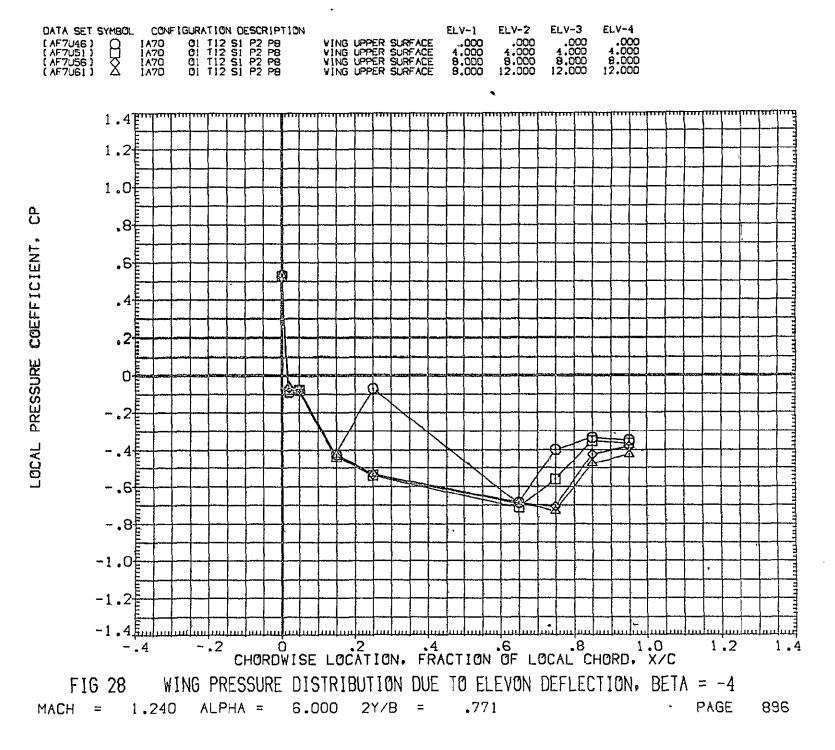


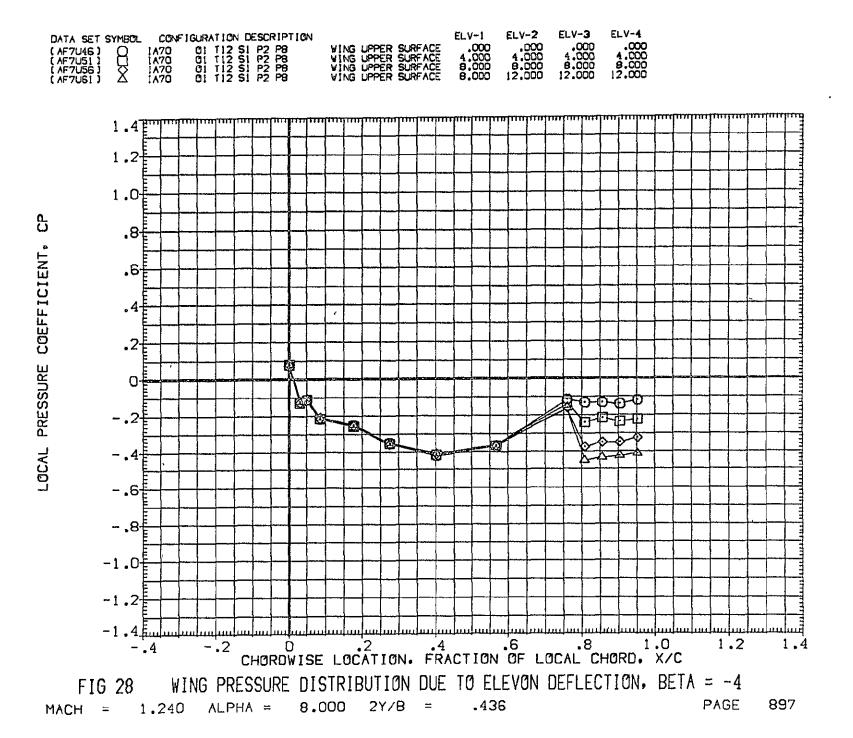


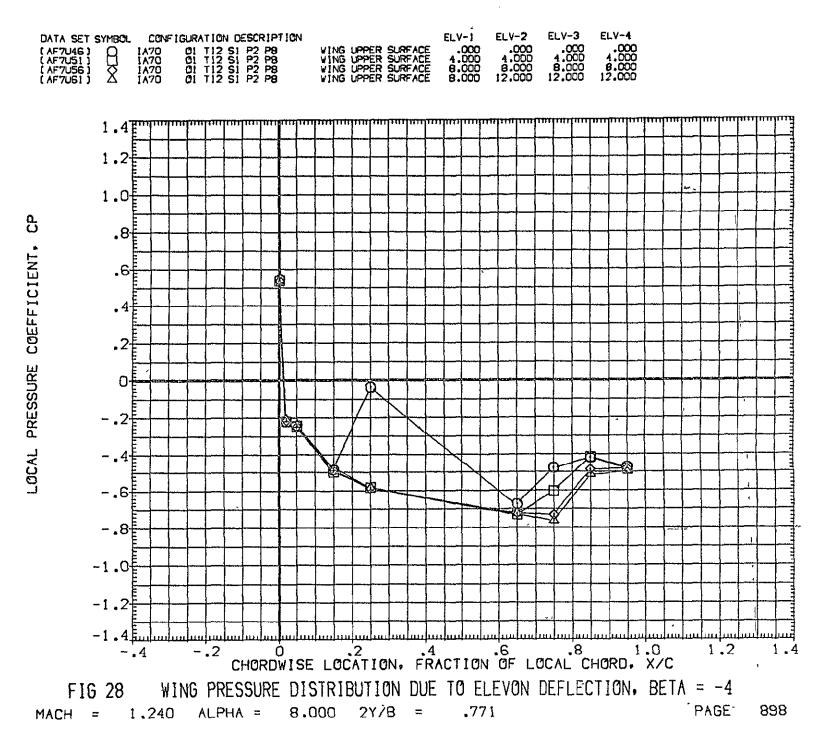


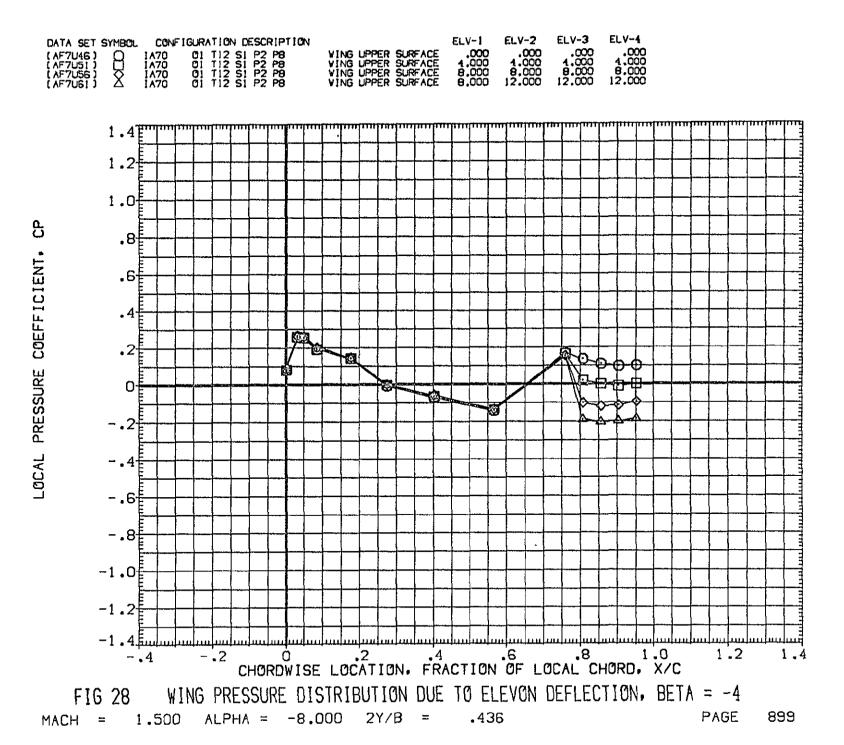


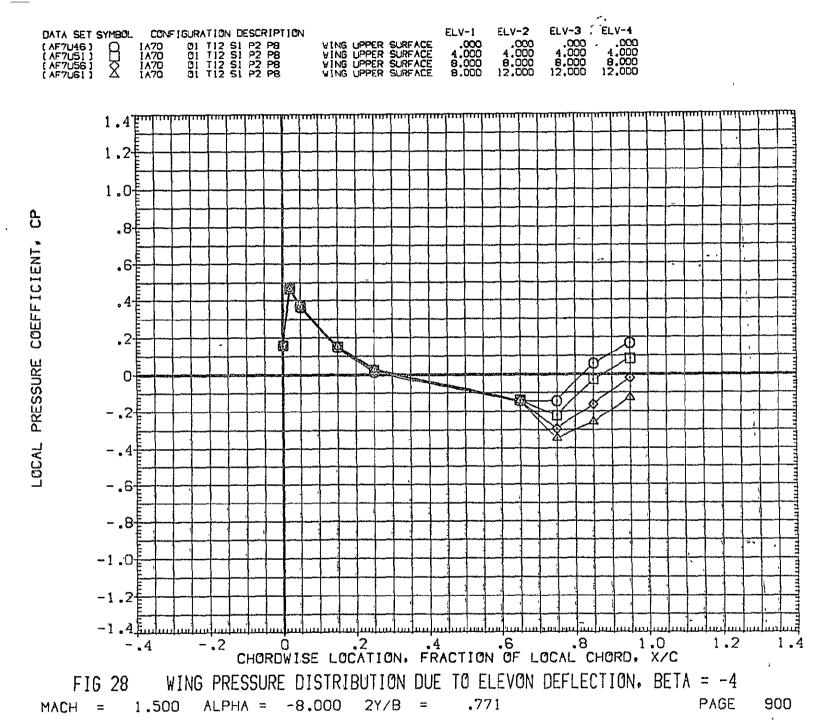


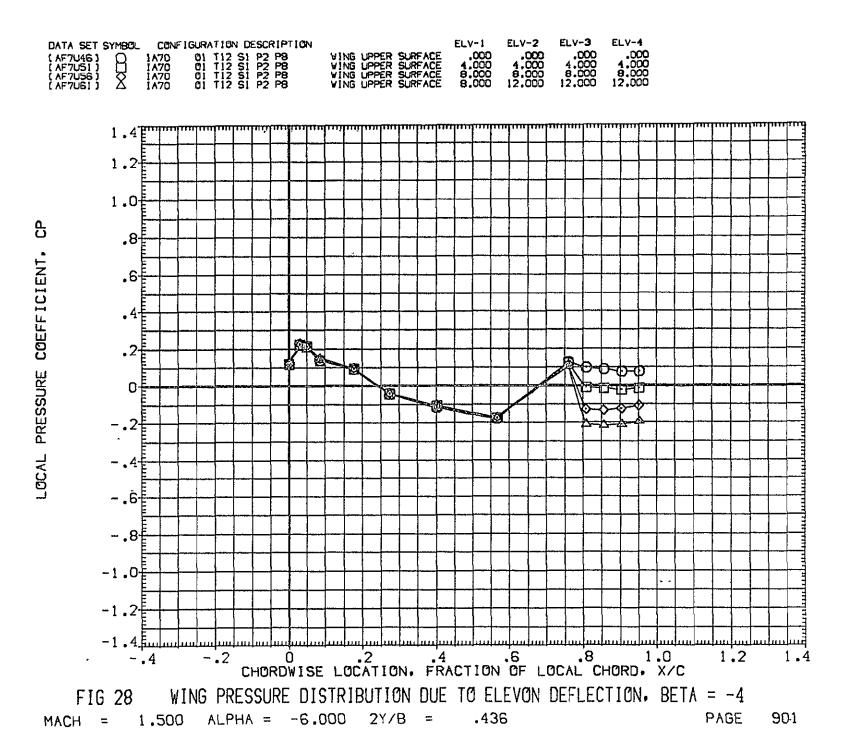


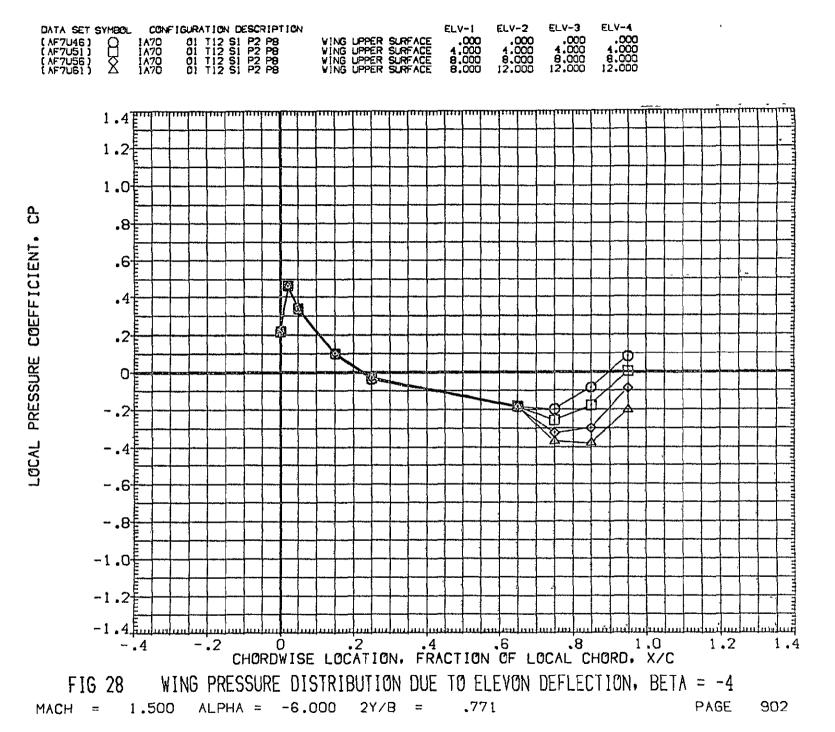


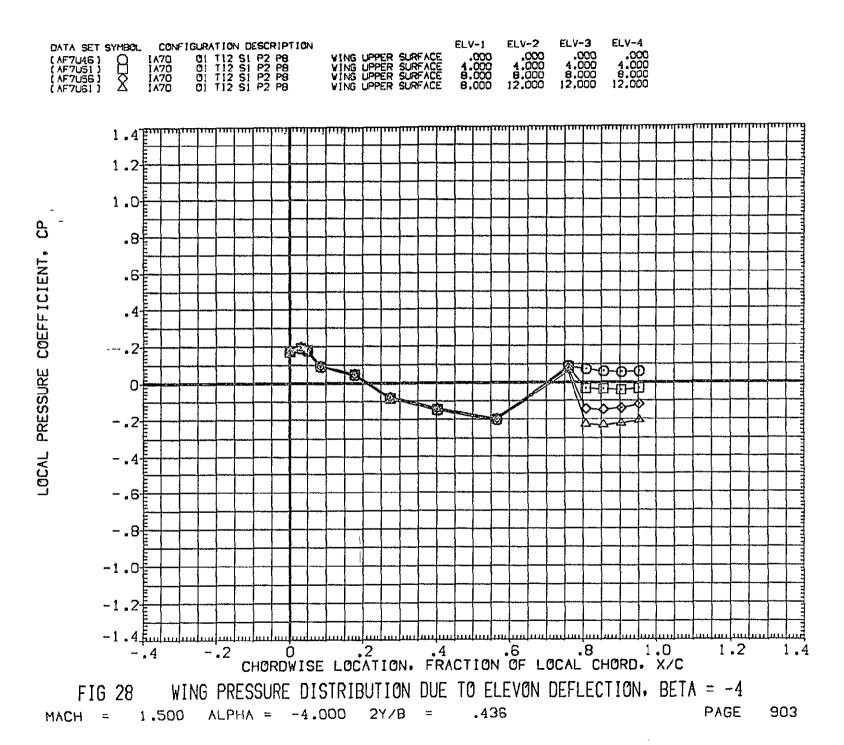


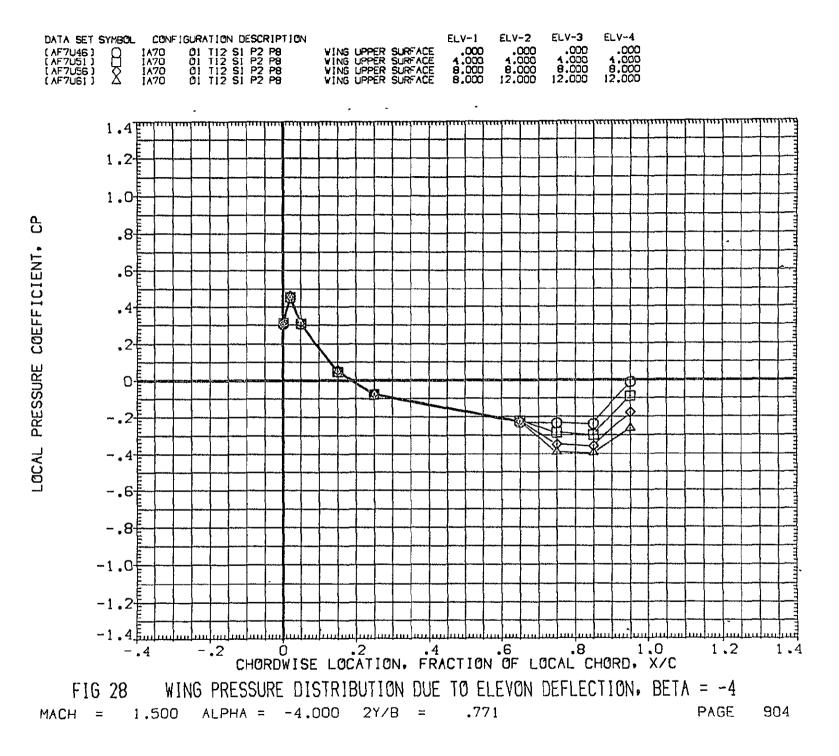


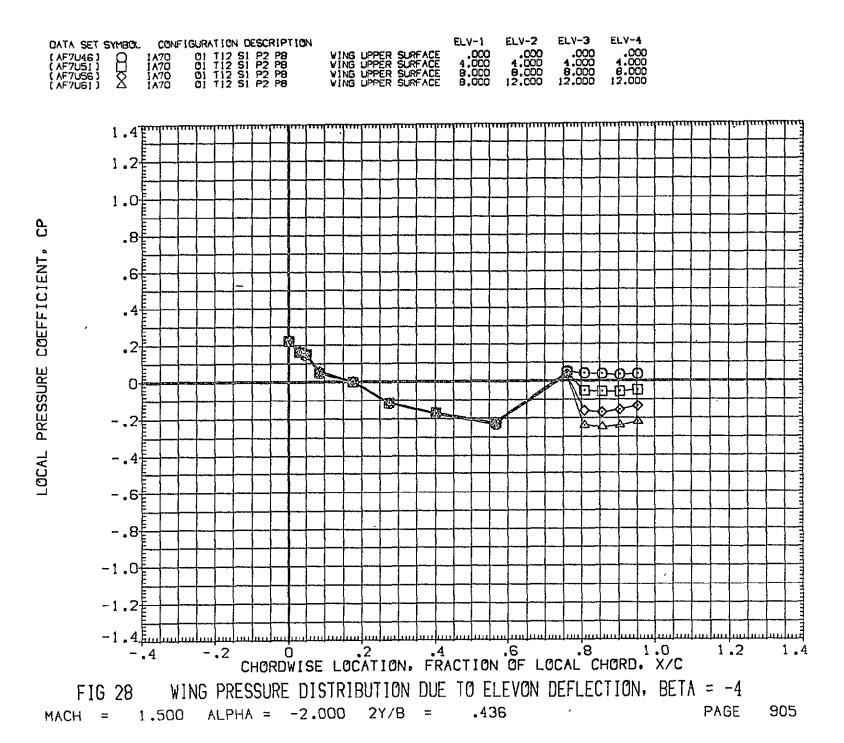


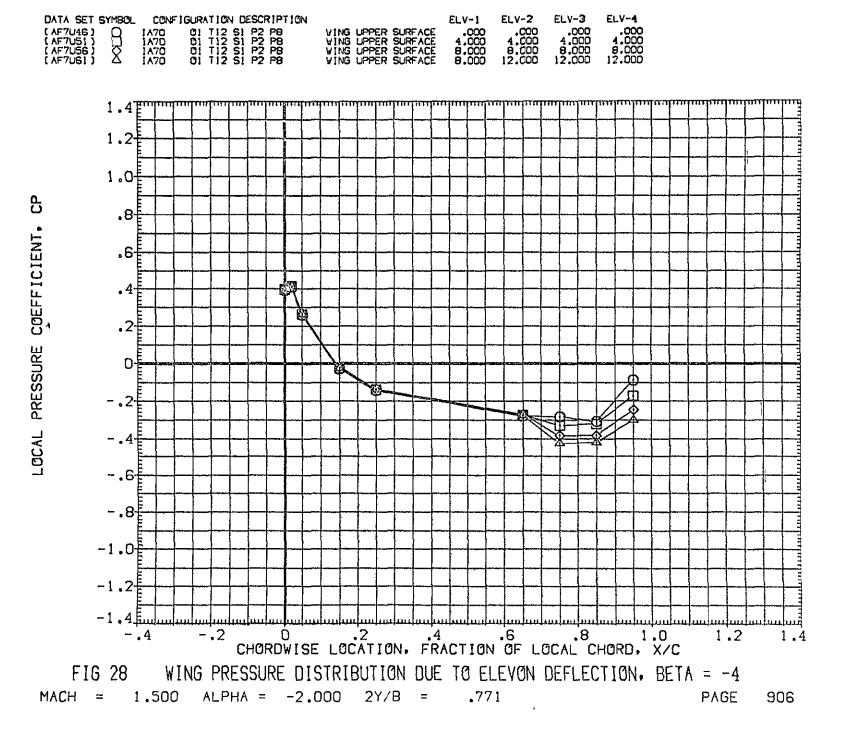


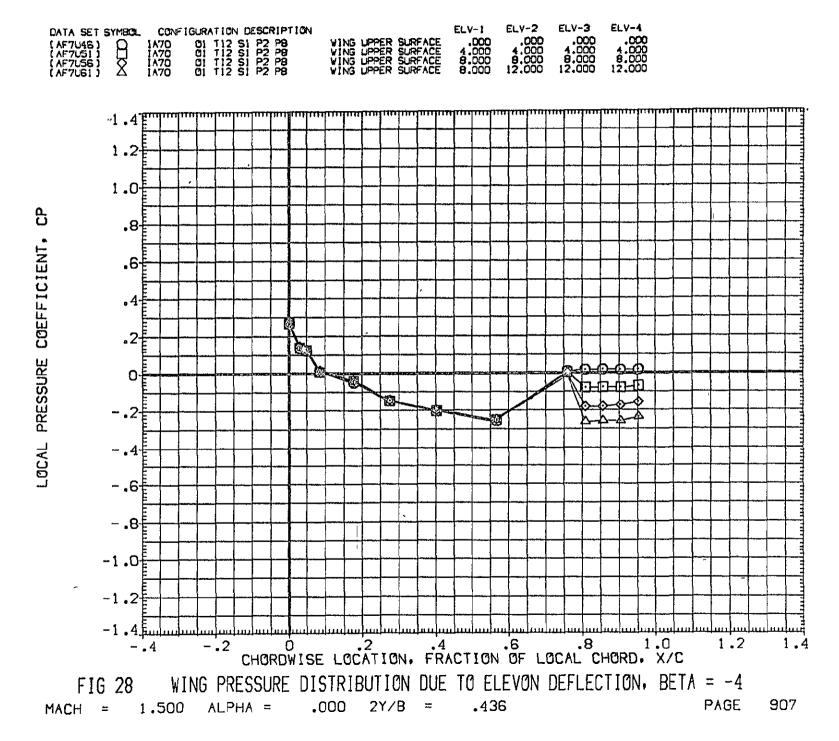


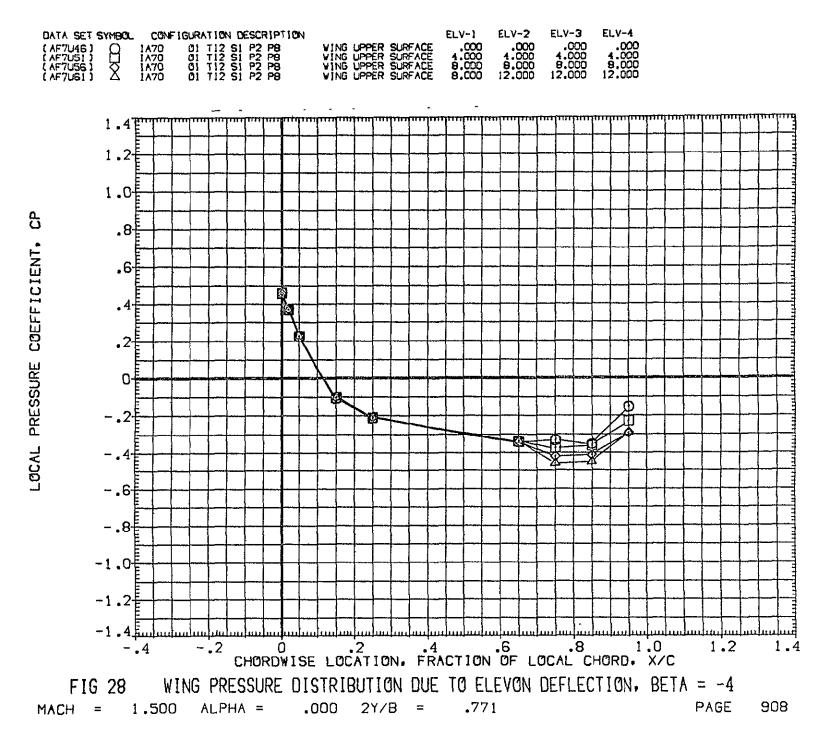


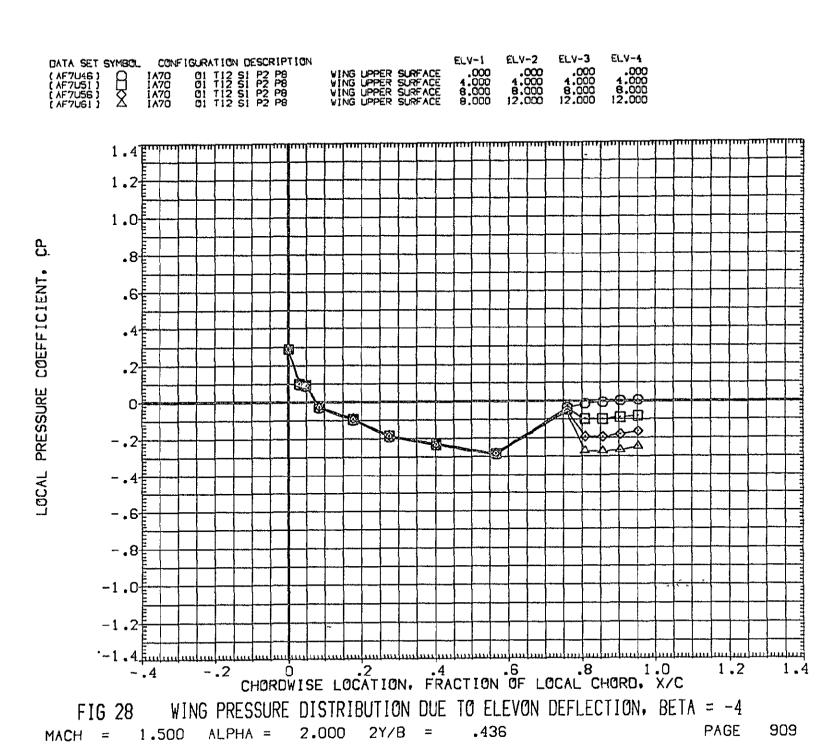


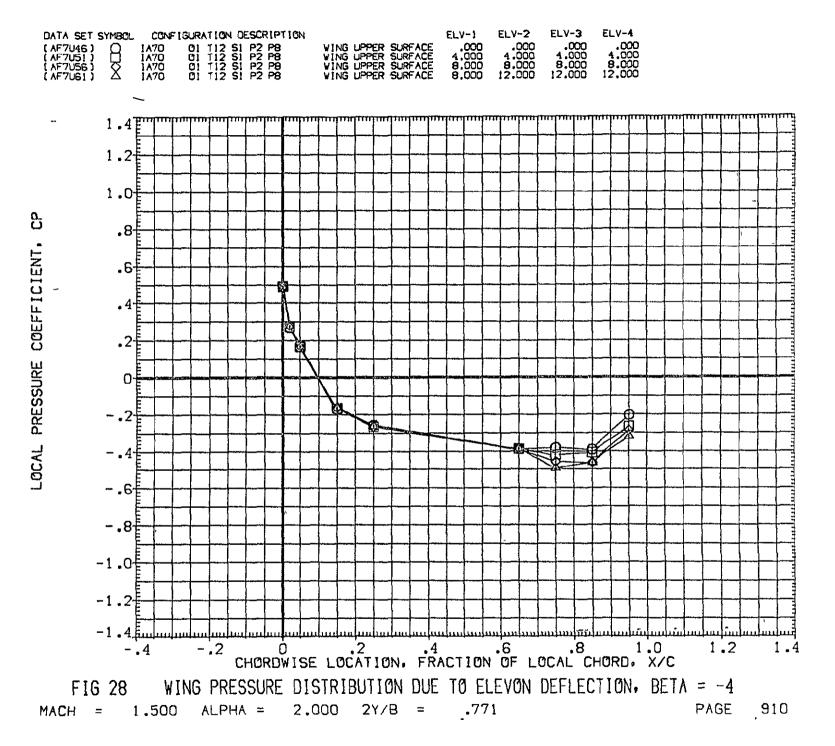


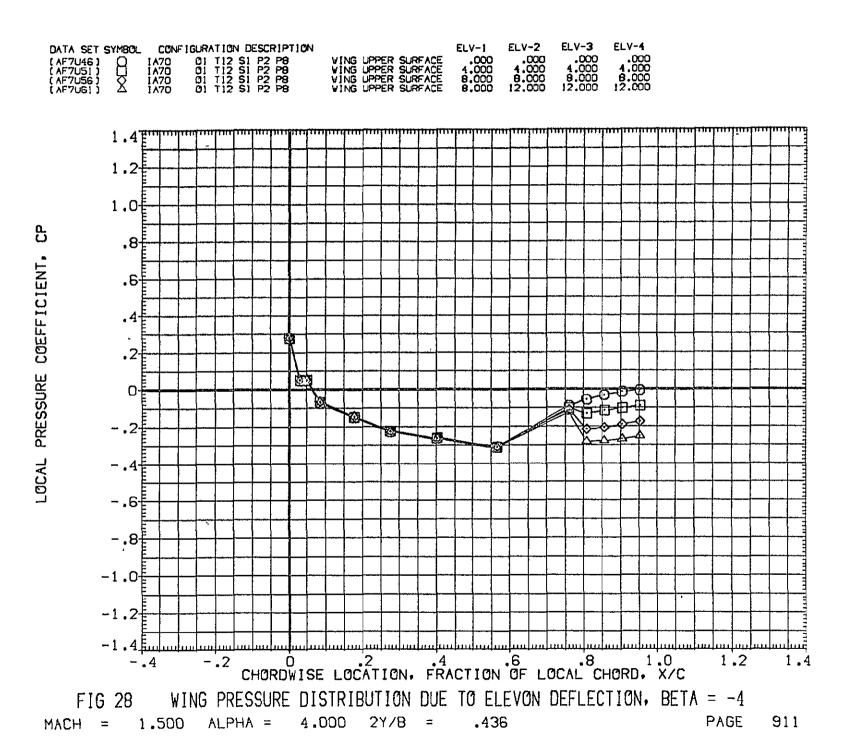


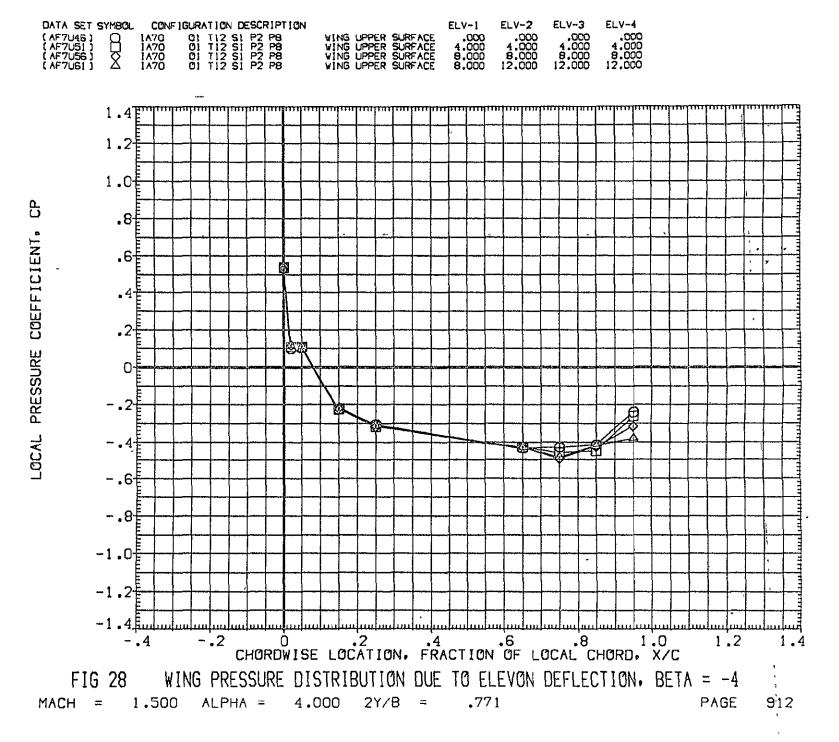


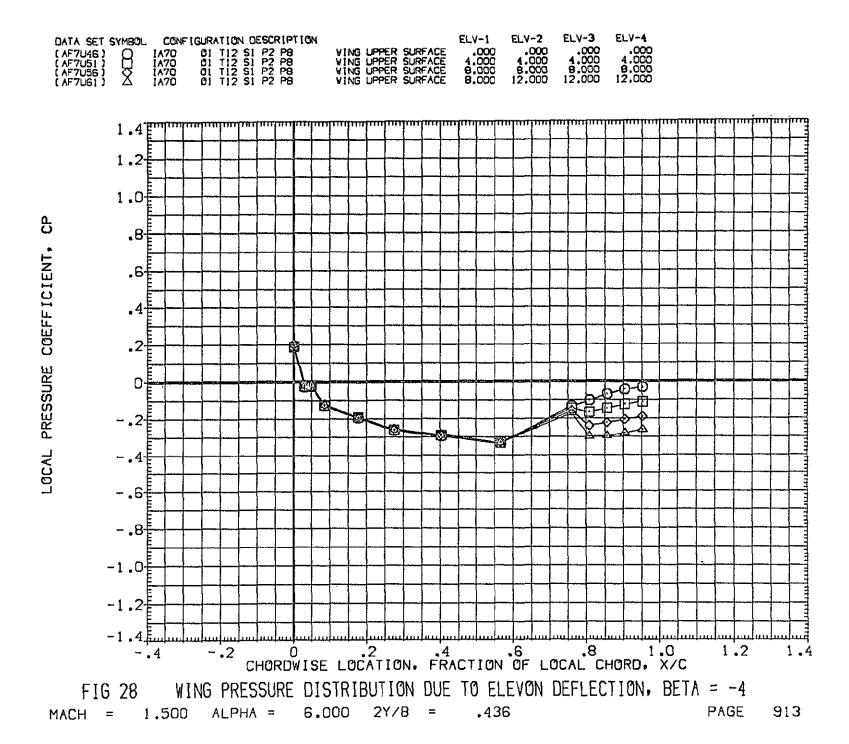


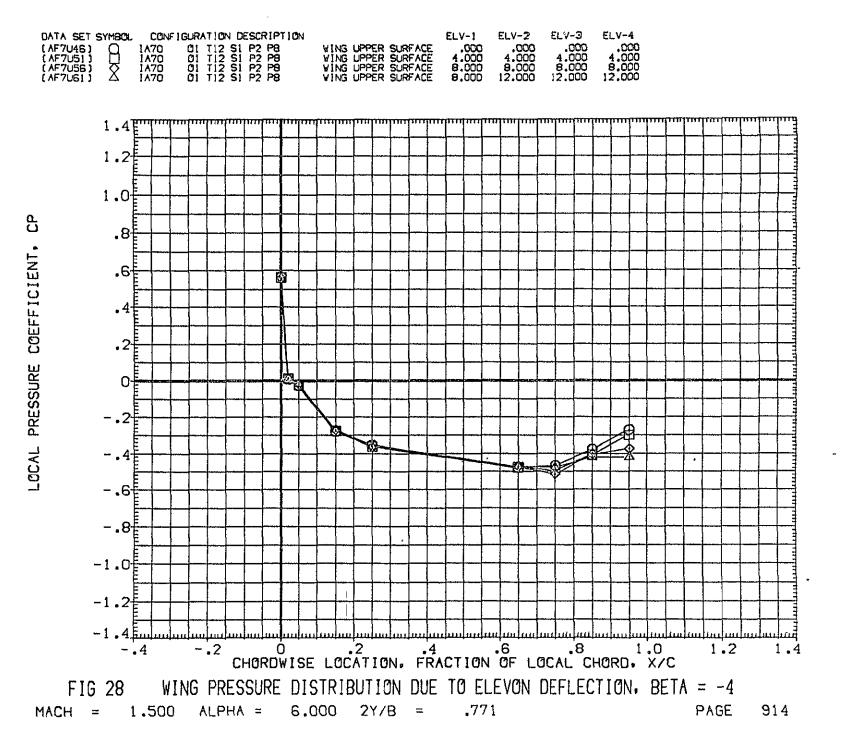


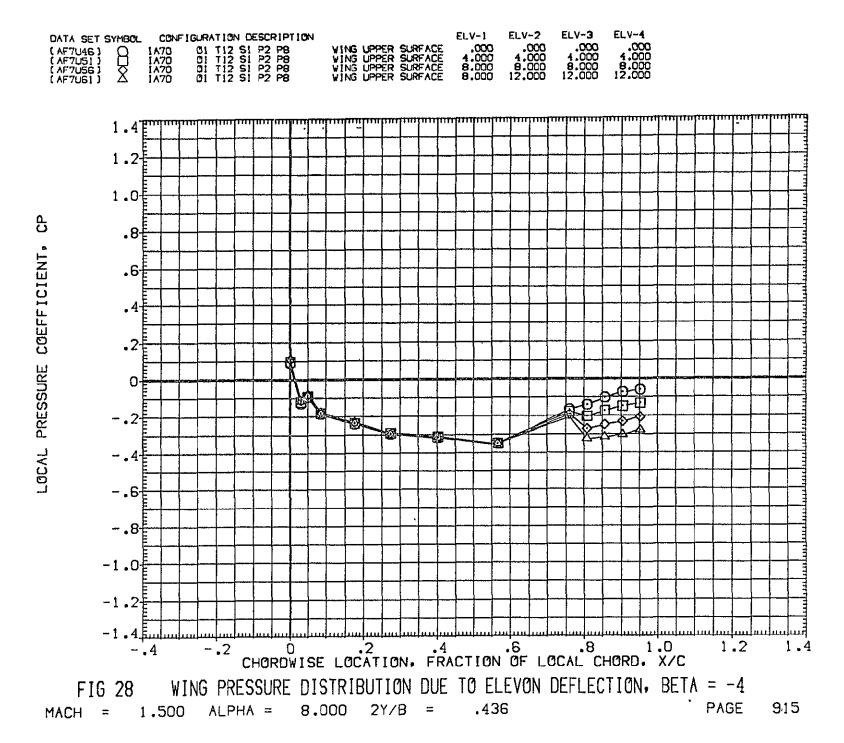


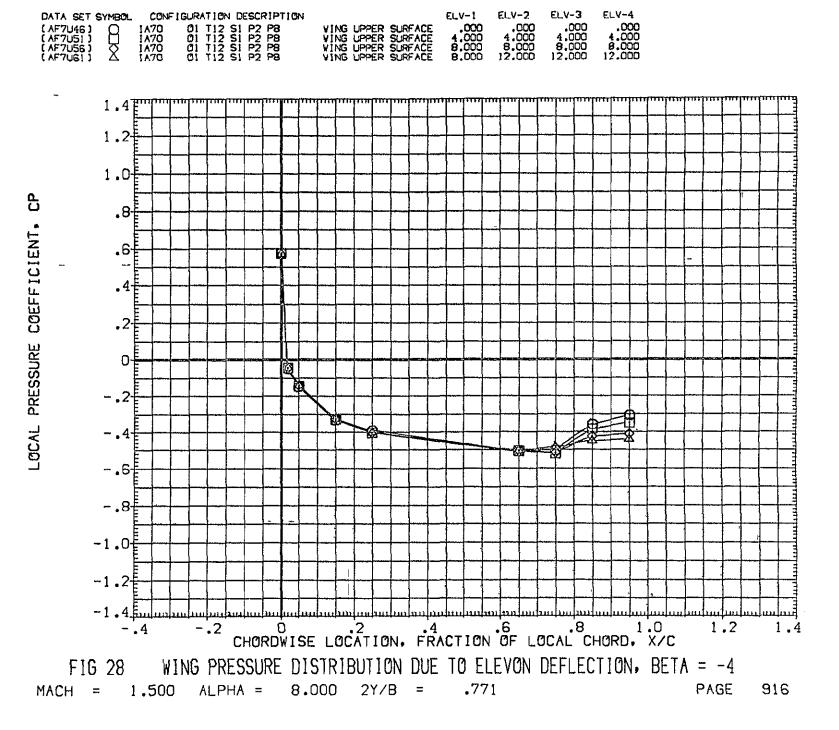


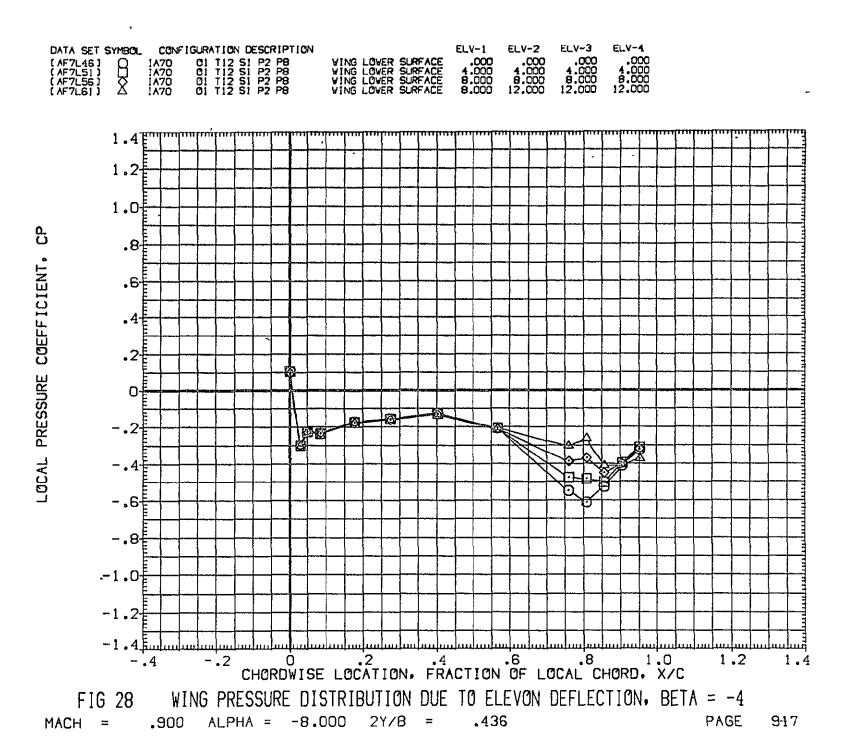


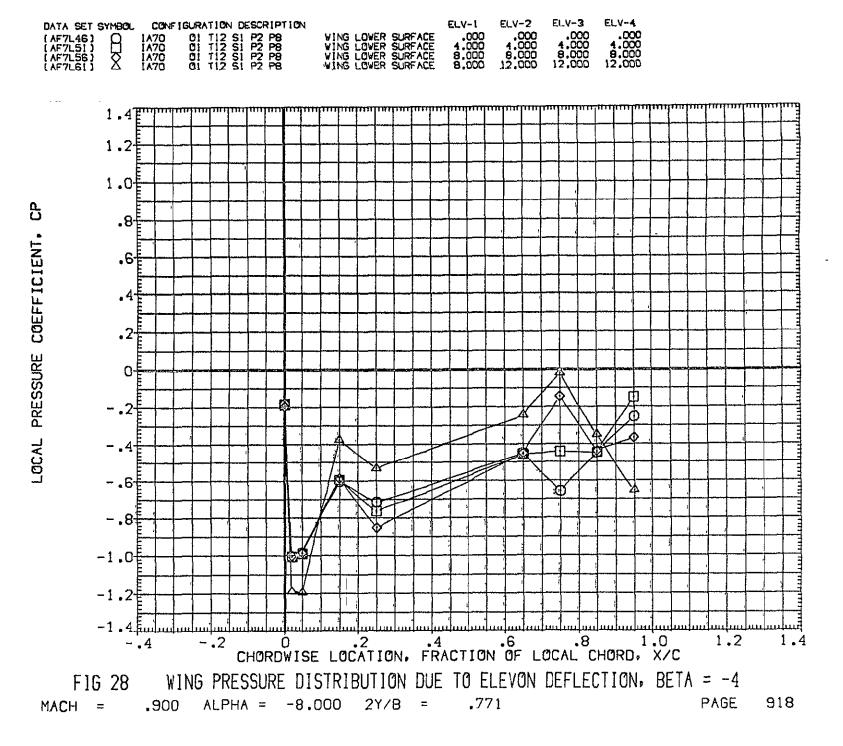


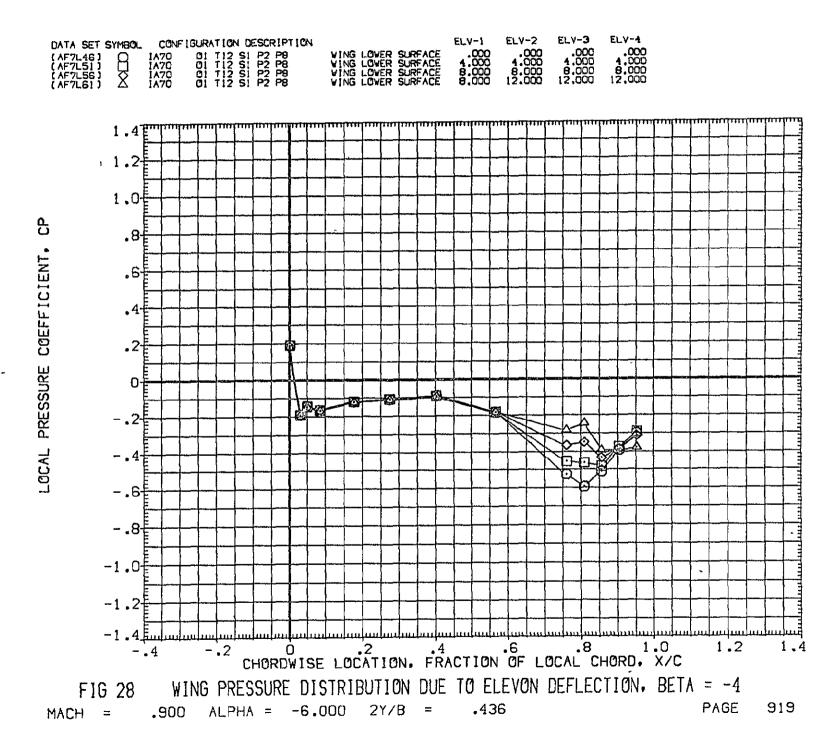


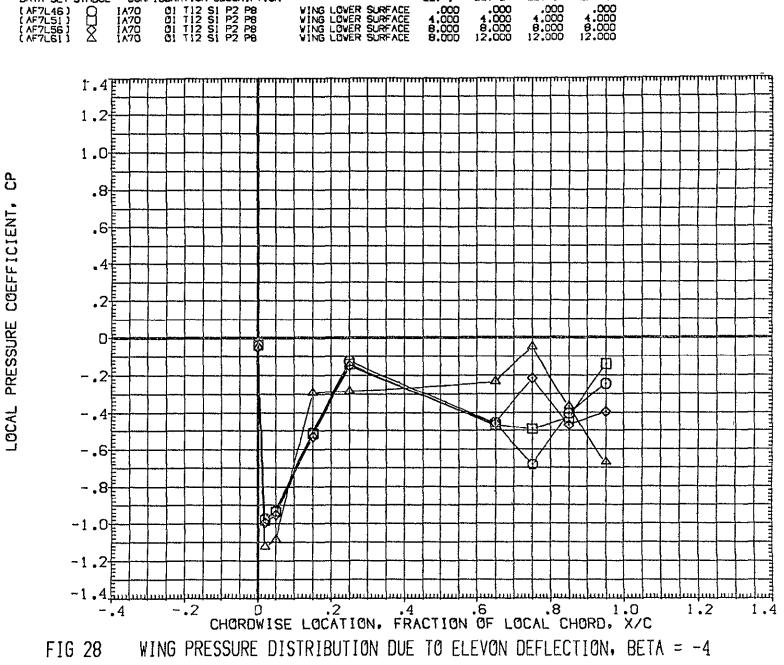












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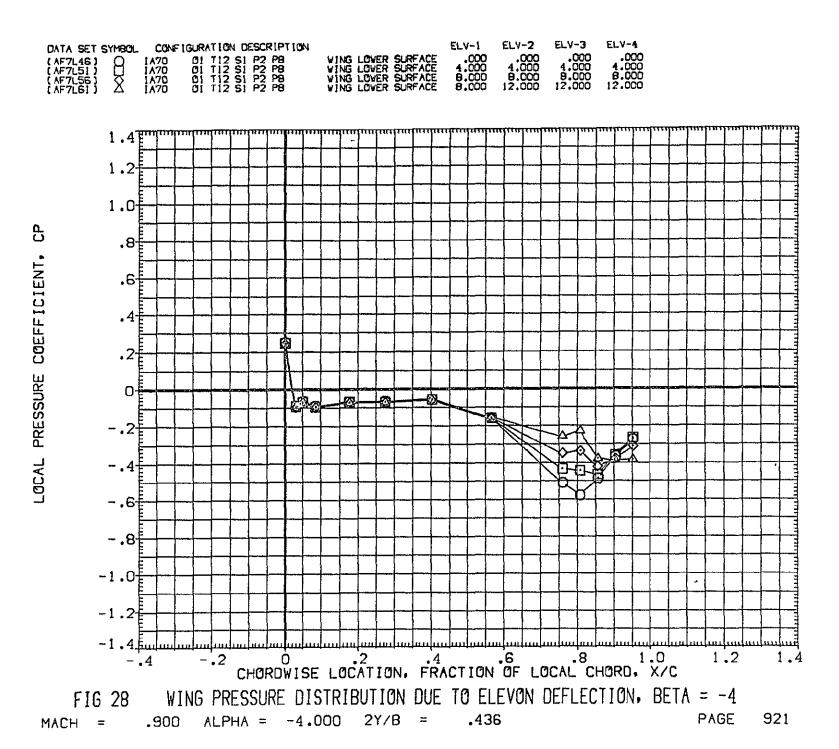
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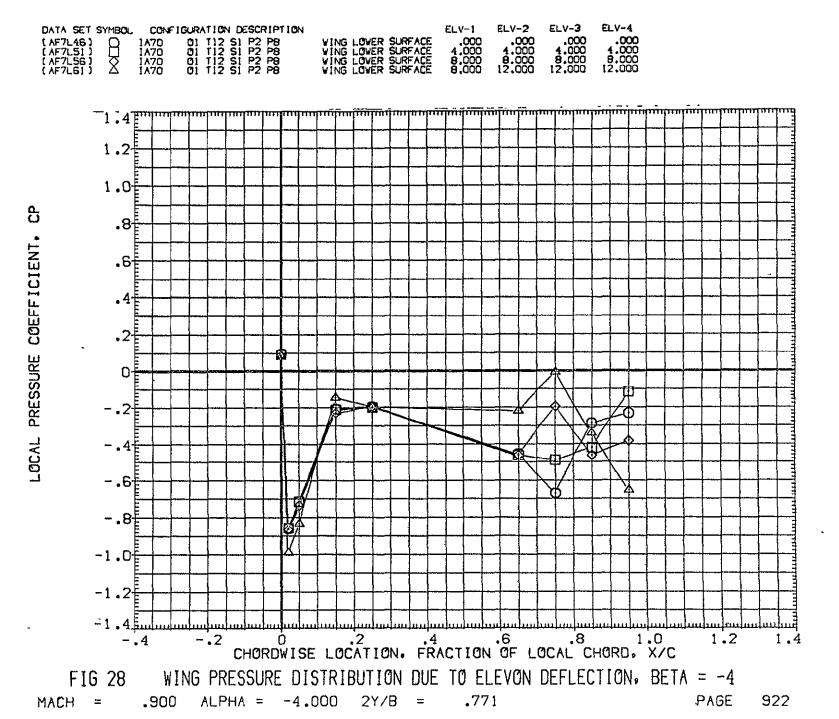
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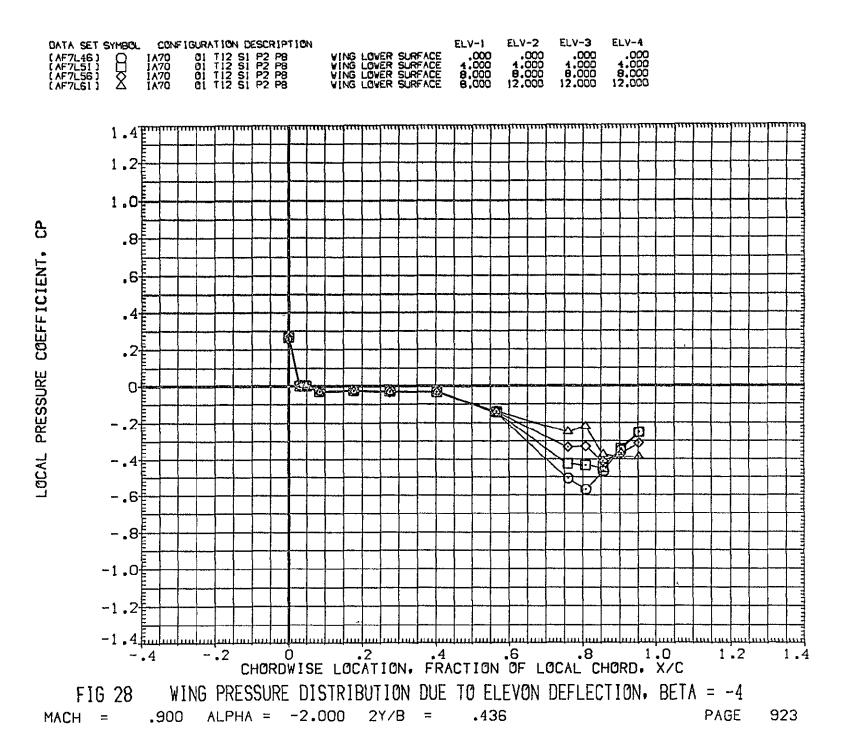
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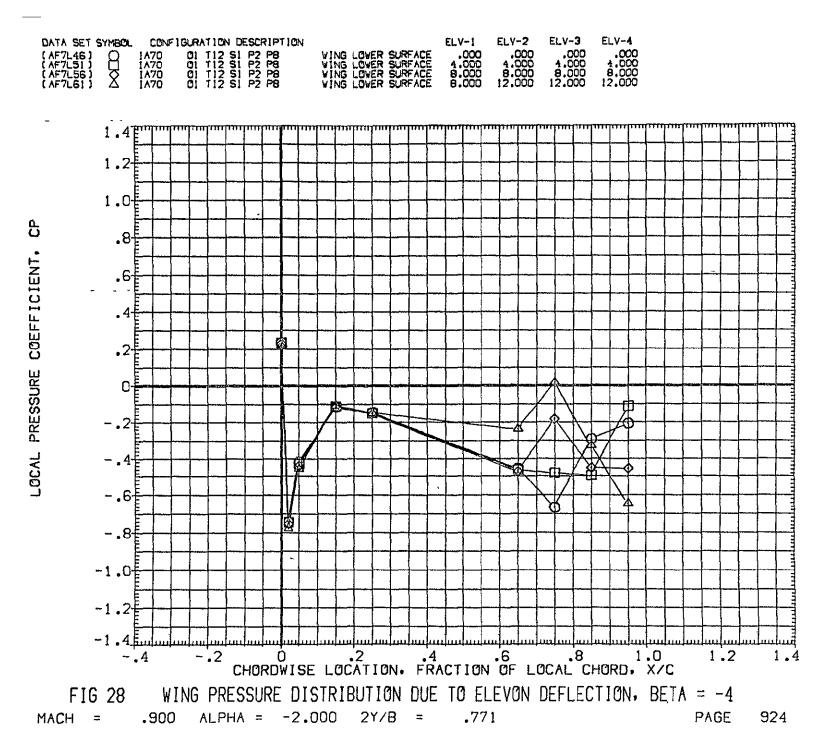
DATA SET SYMBOL CONFIGURATION DESCRIPTION

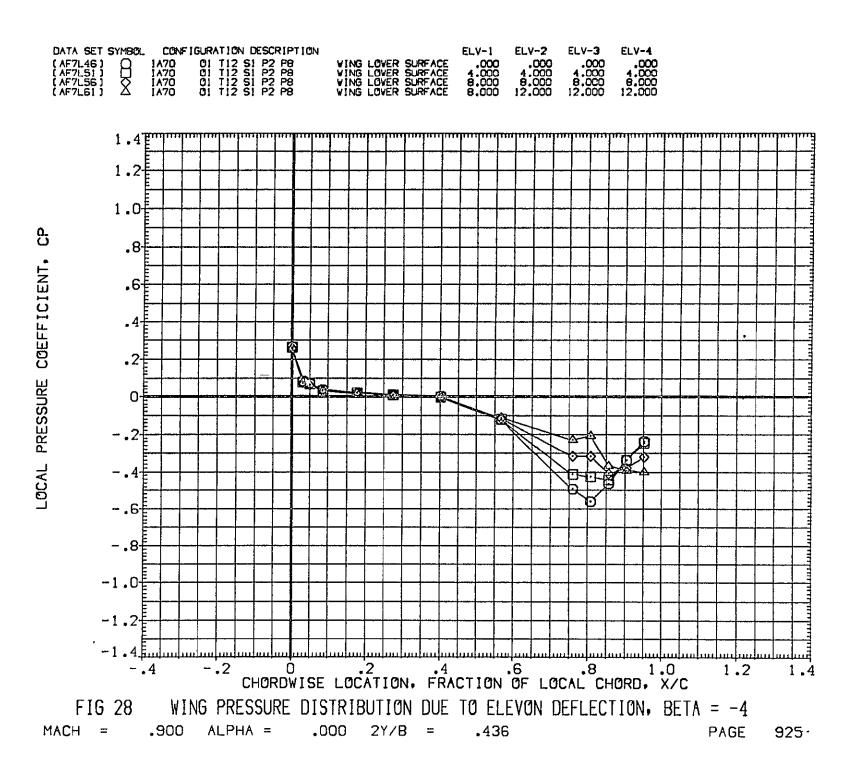
MACH = .900 ALPHA = -6.000 2Y/B = .771PAGE 920

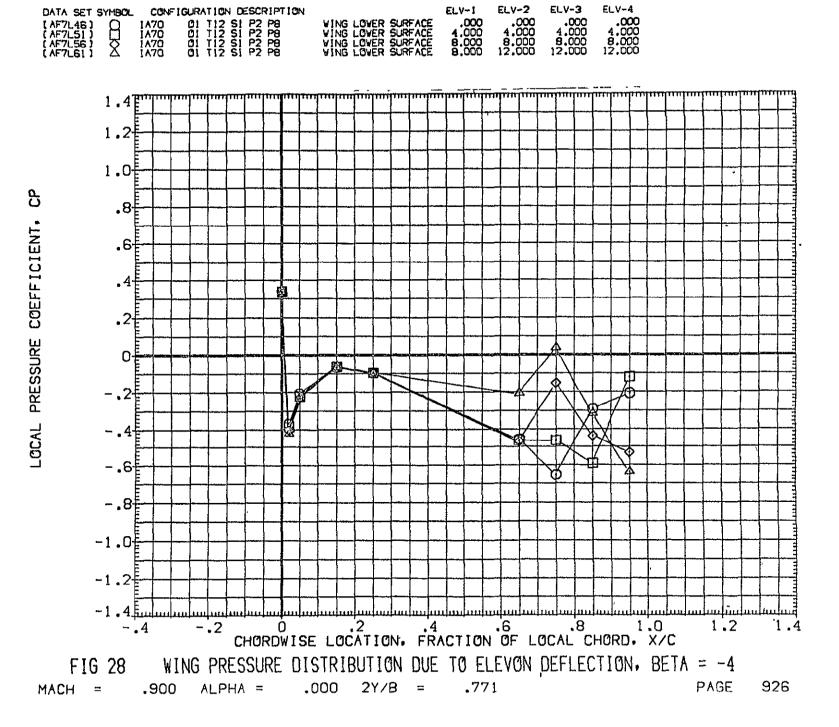


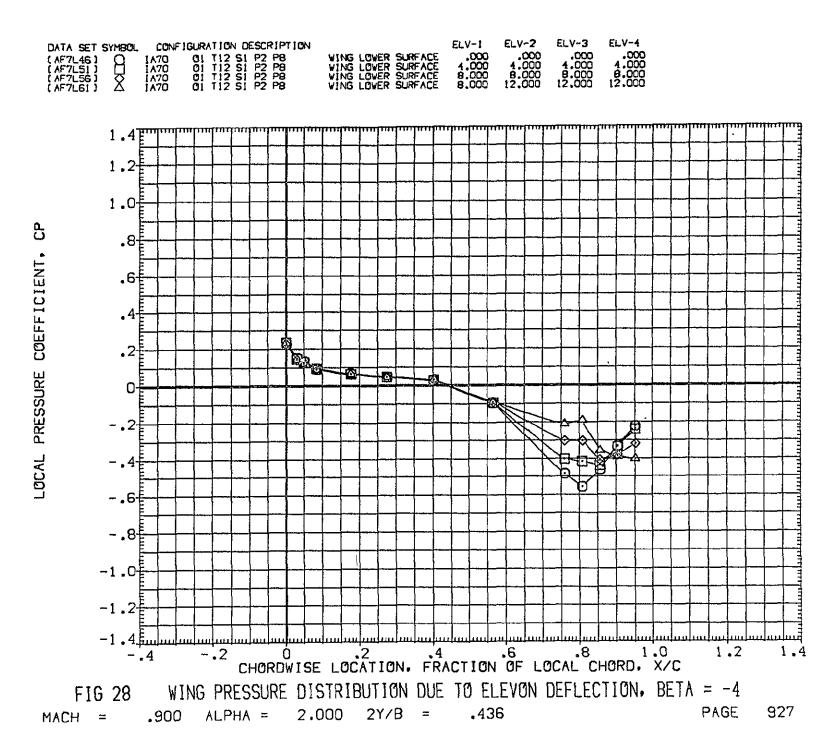


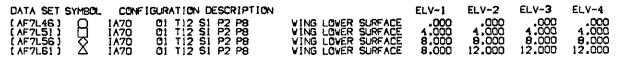


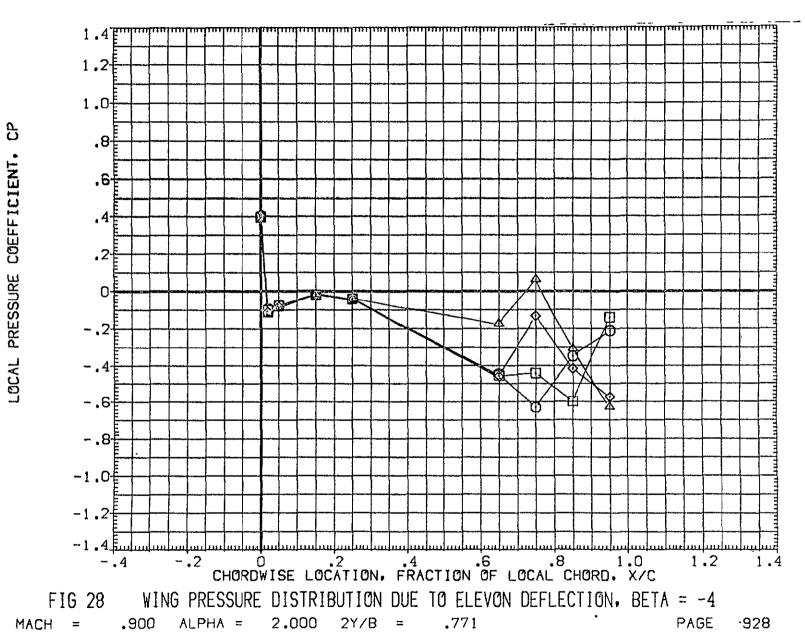


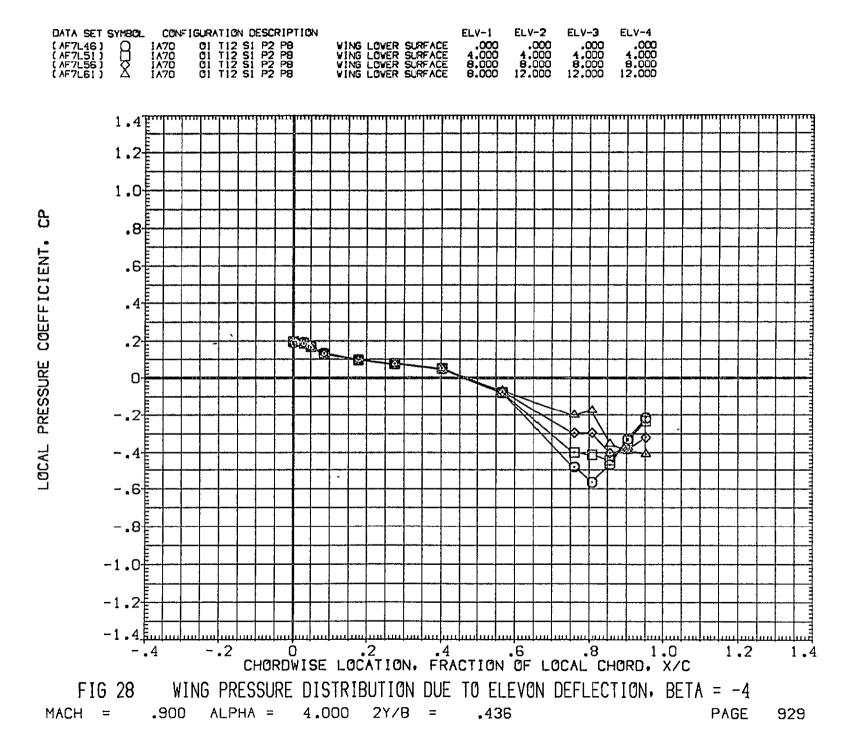


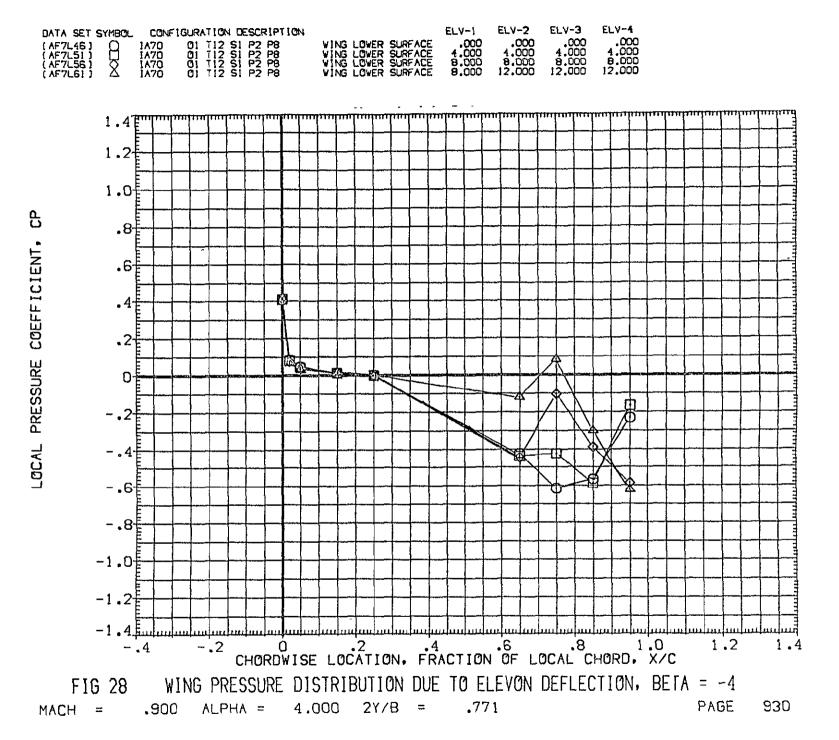


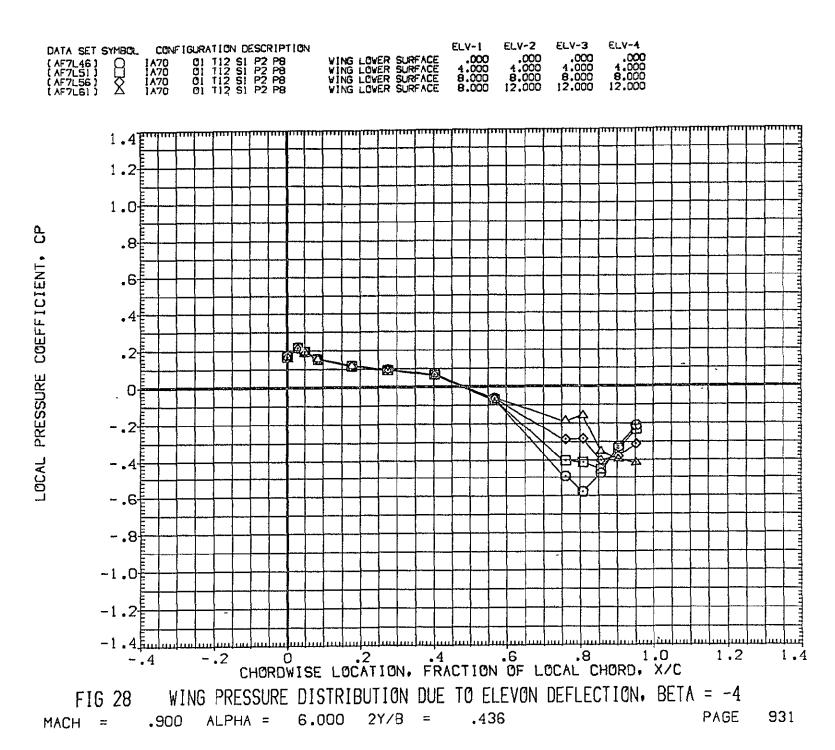


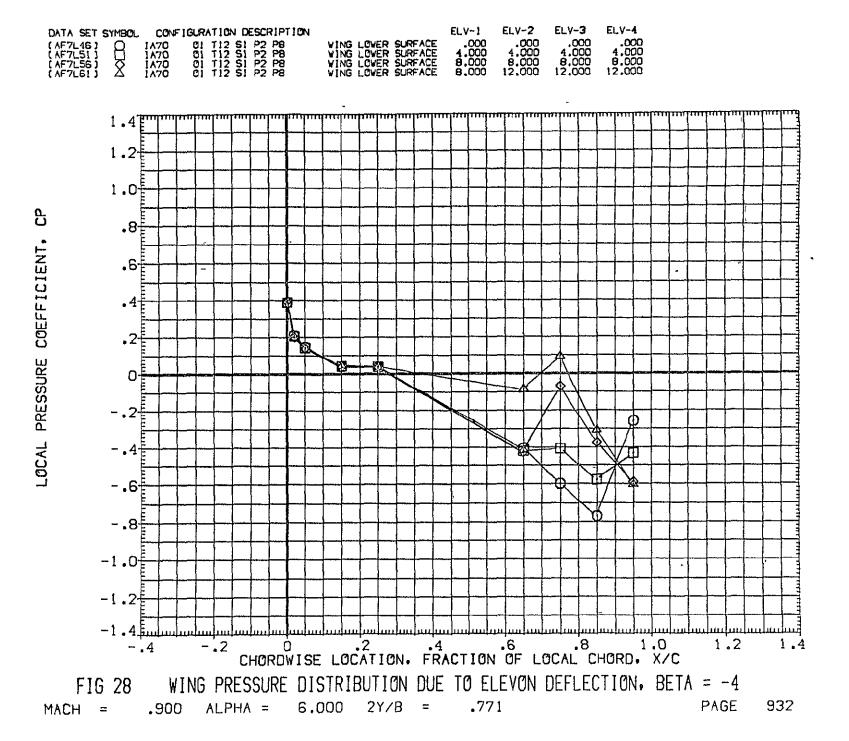


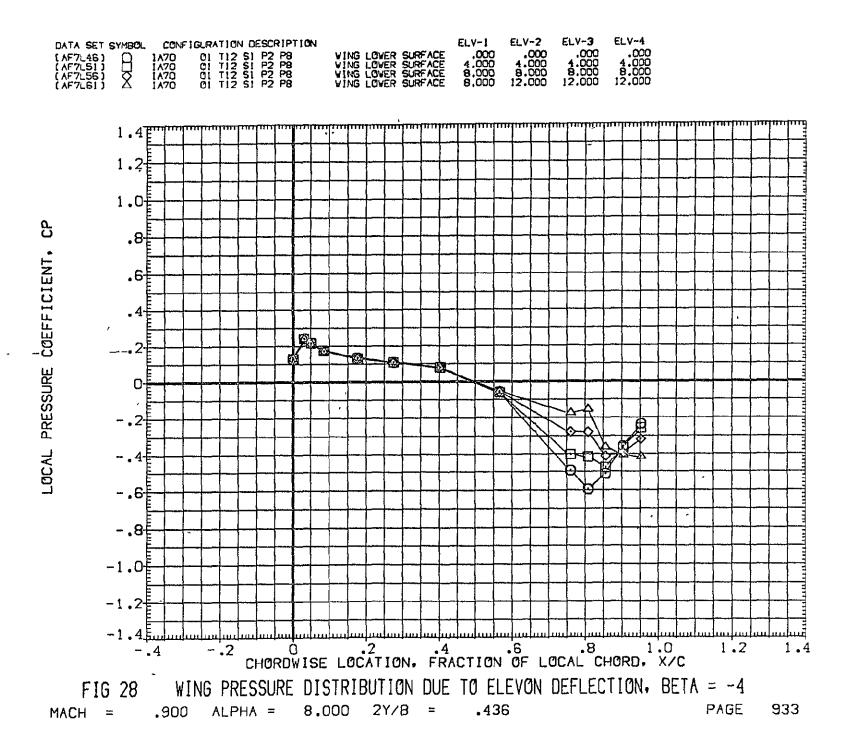


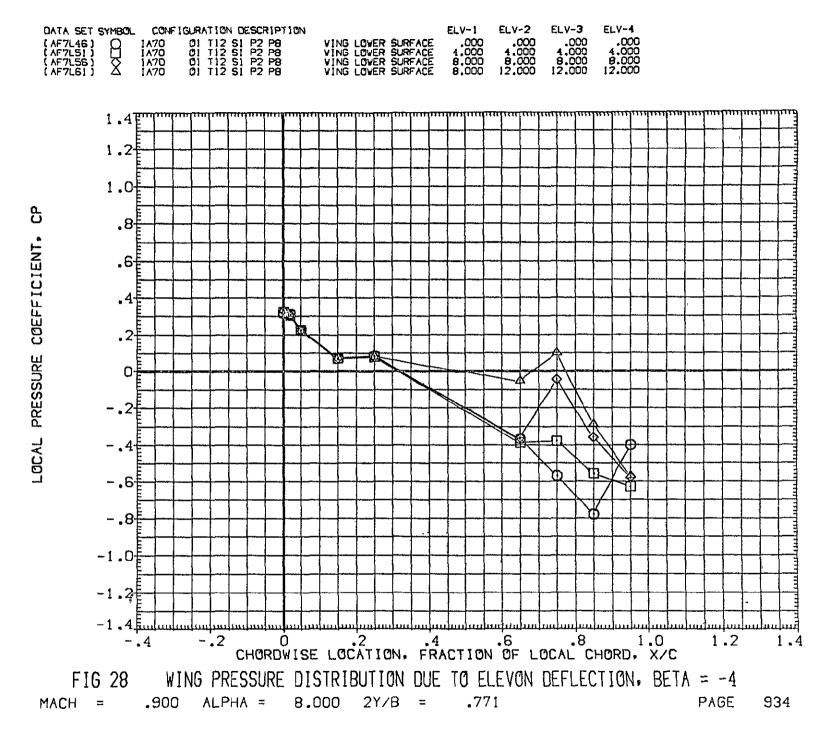


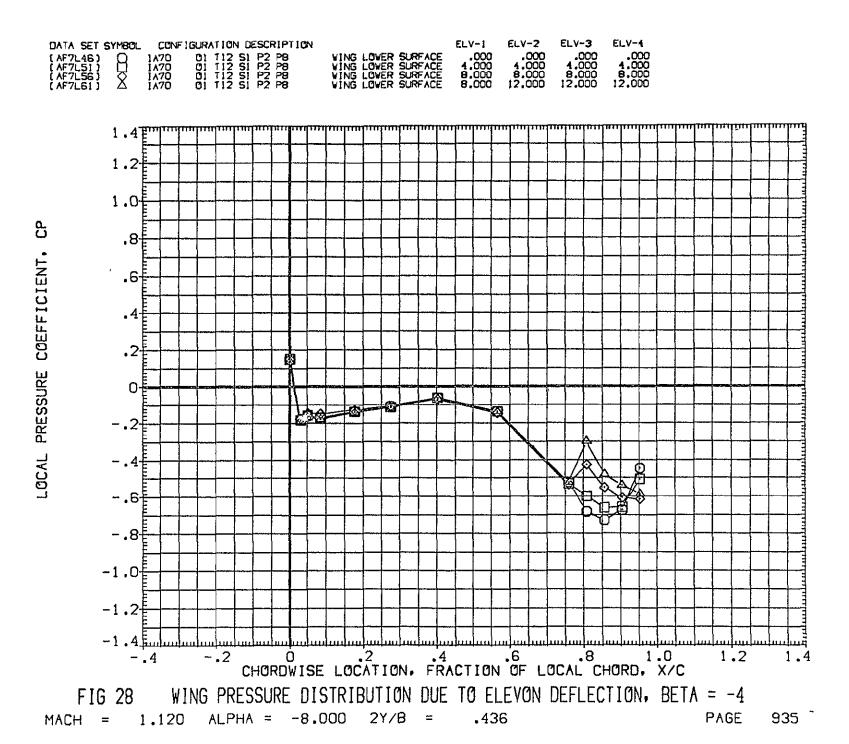


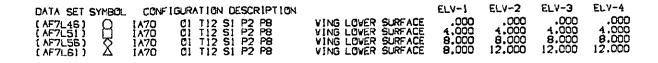












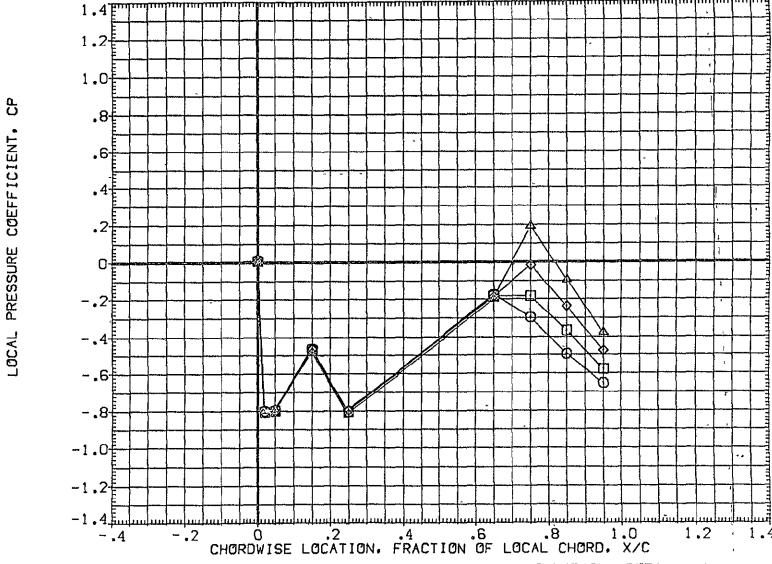
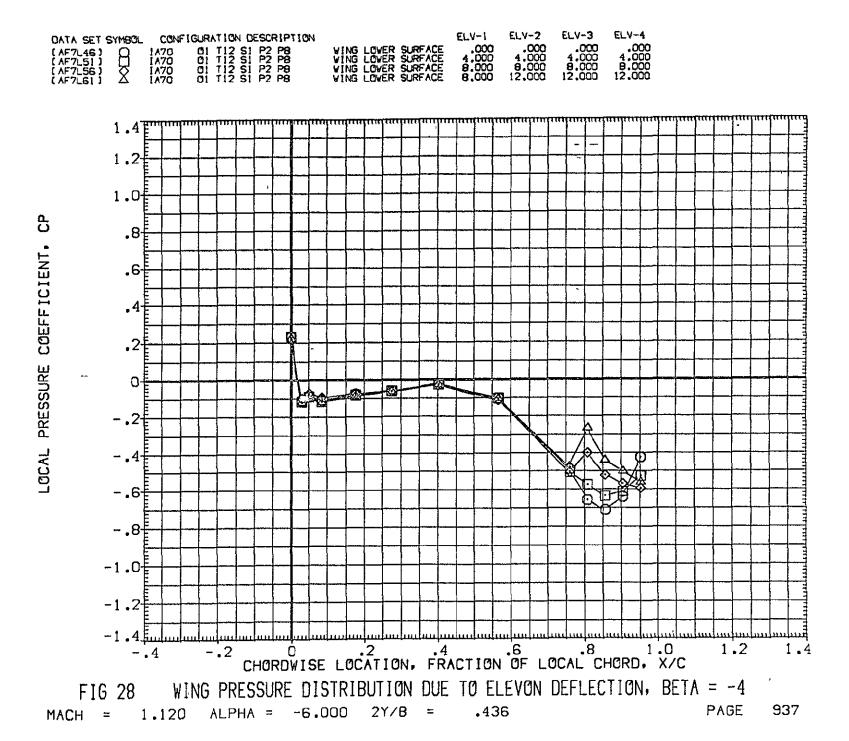
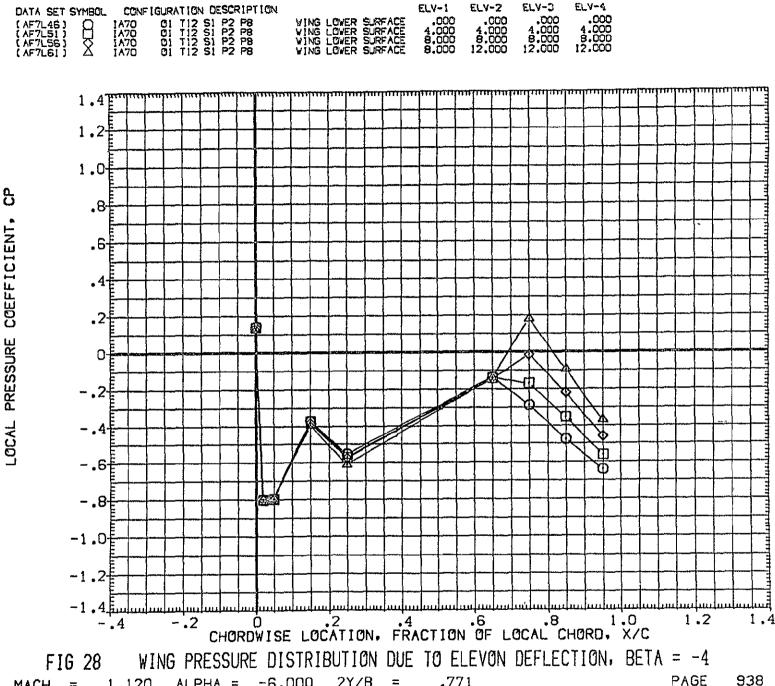


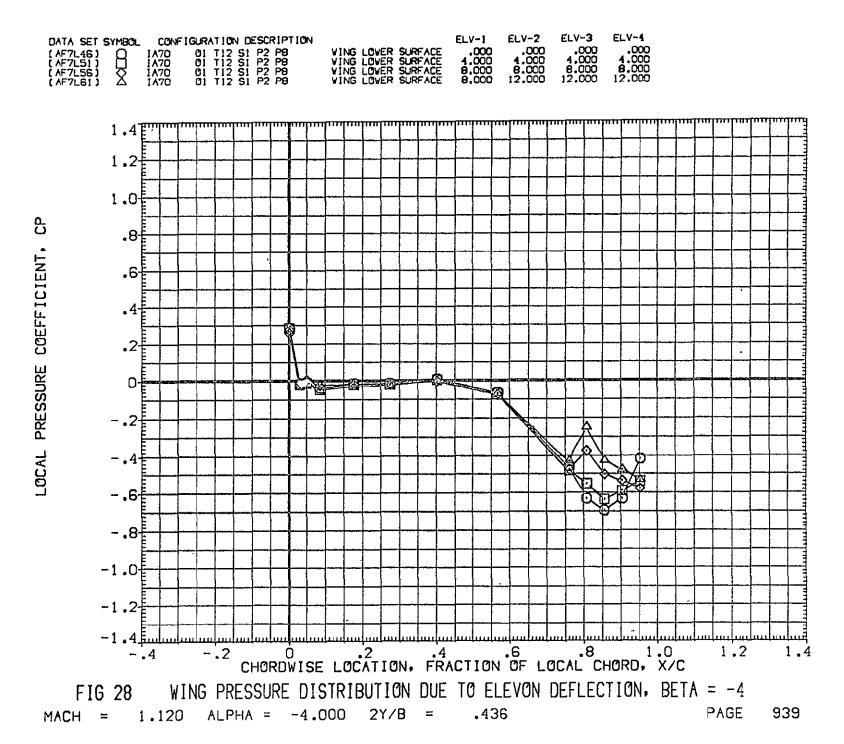
FIG 28 WING PRESSURE DISTRIBUTION DUE TO ELEVON DEFLECTION. BETA = -4

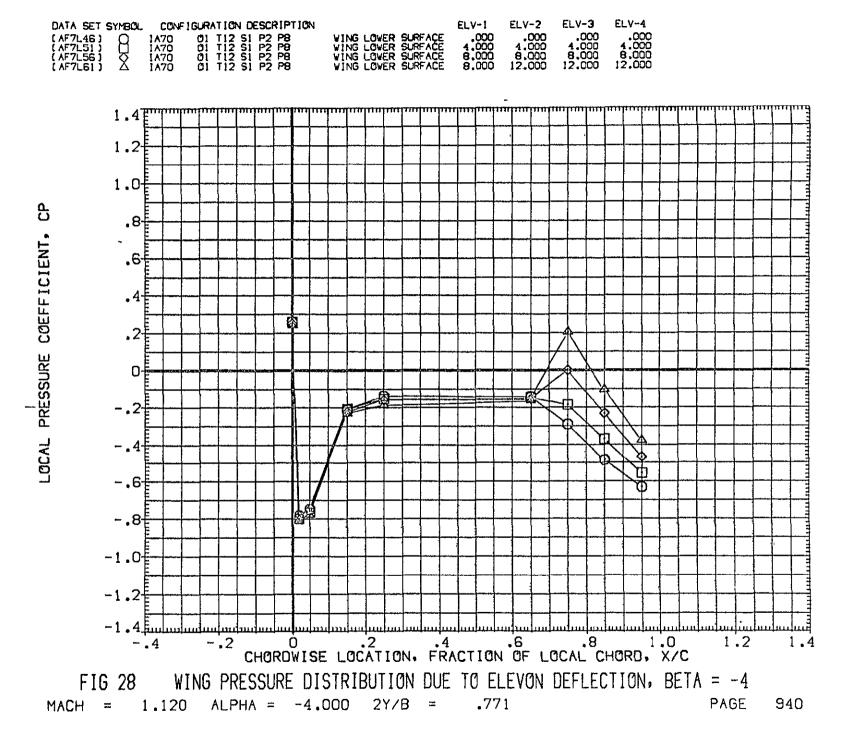
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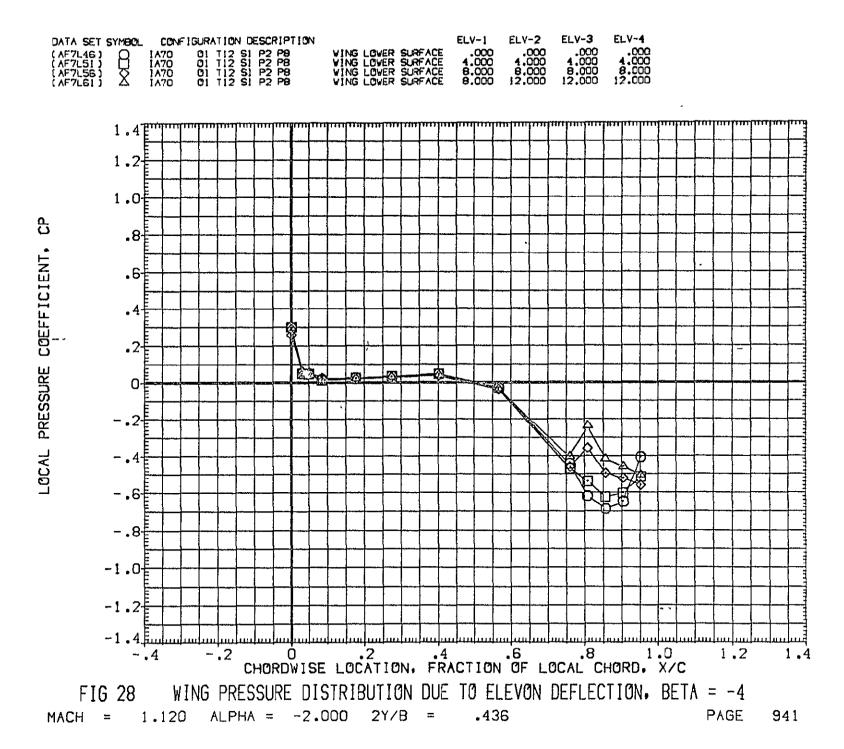


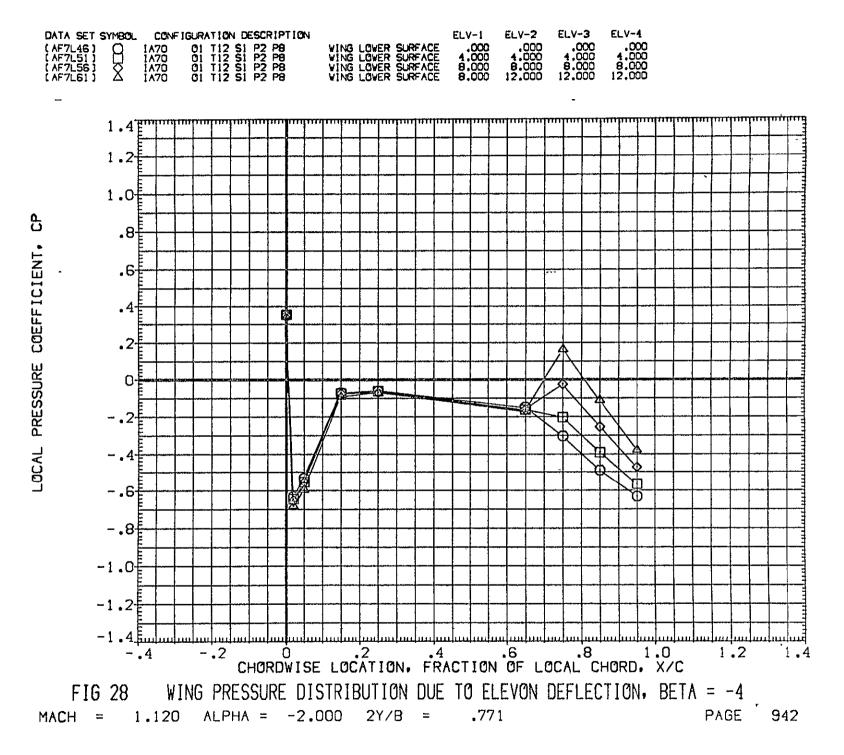


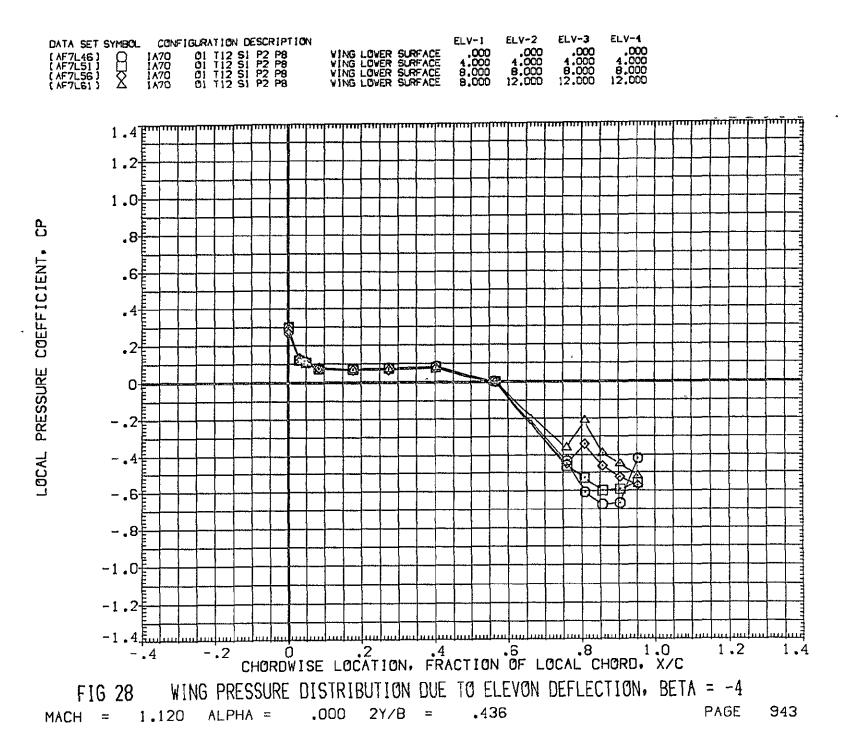
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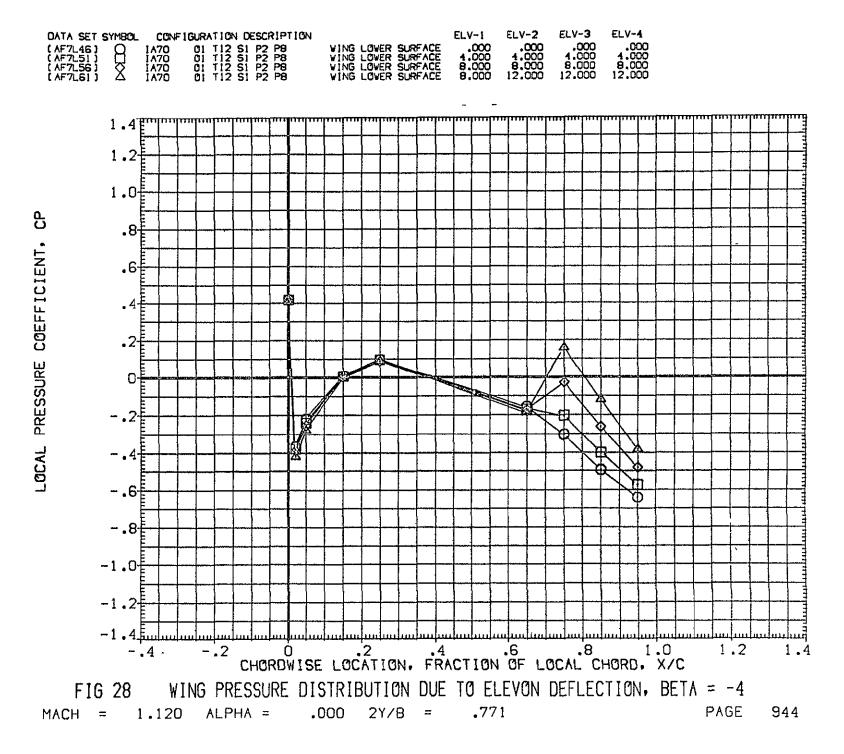


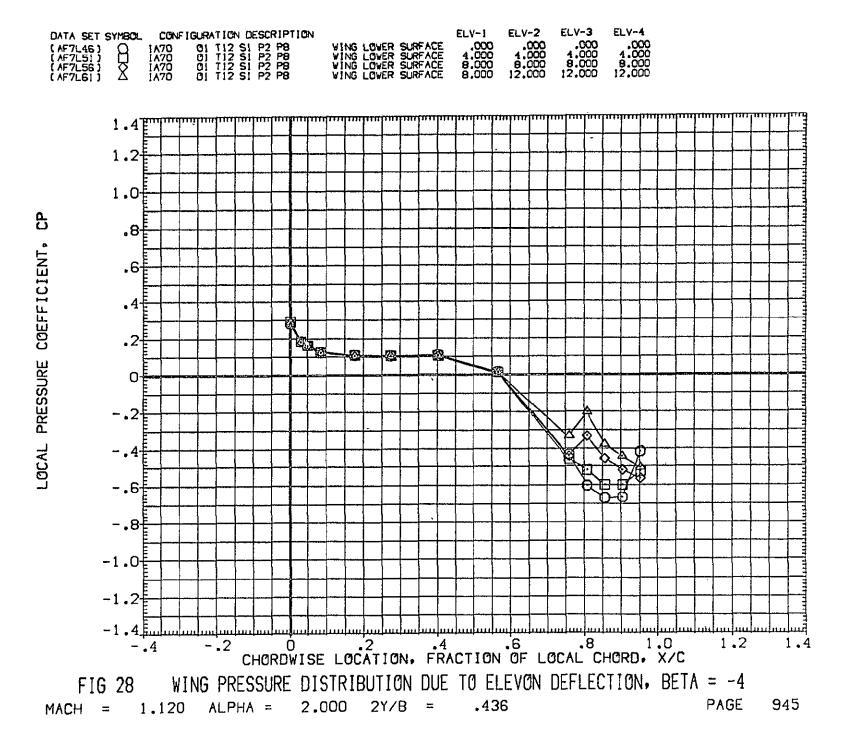


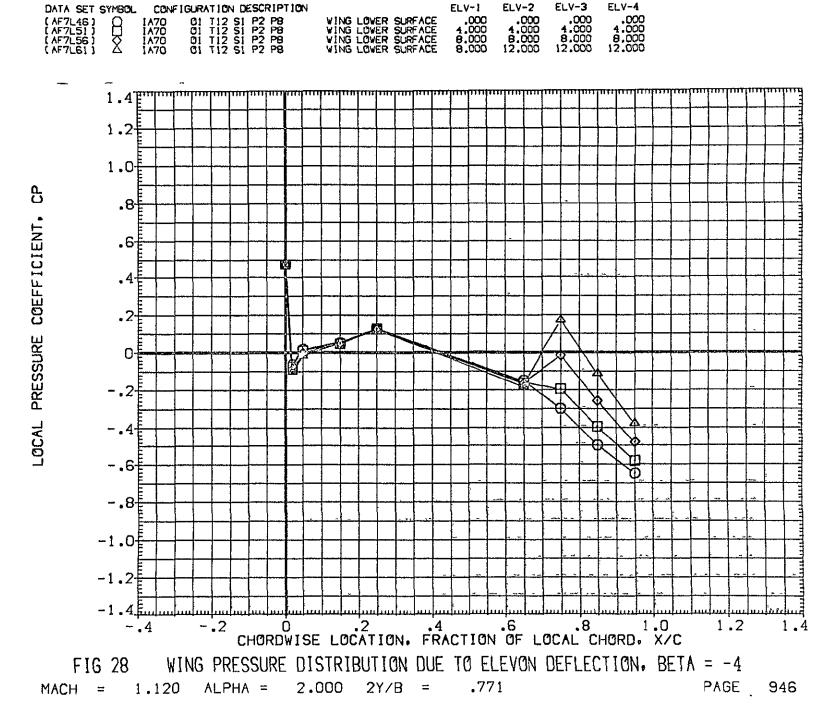


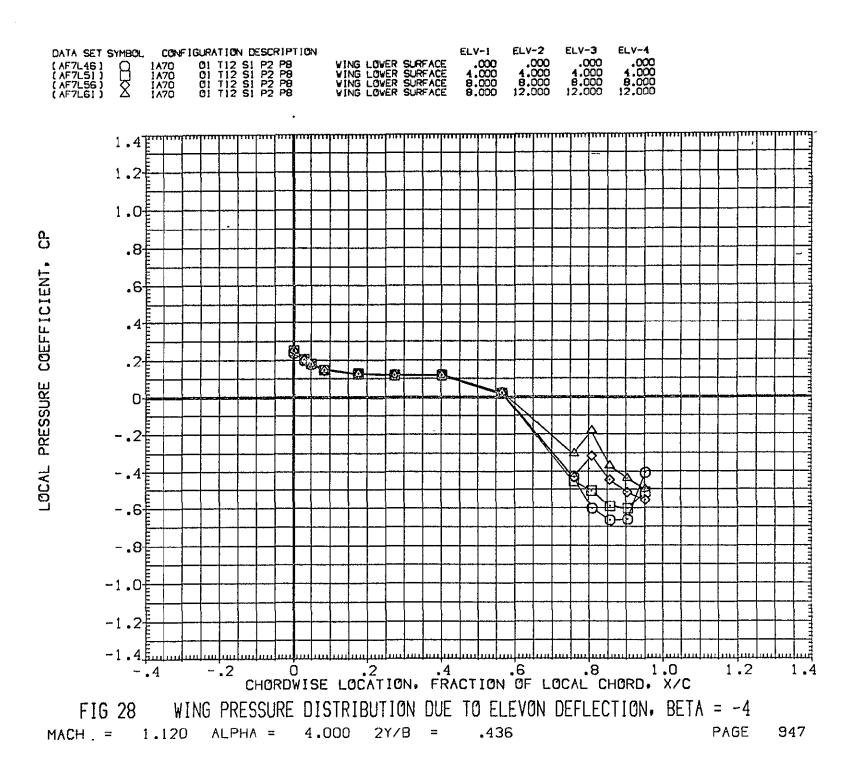


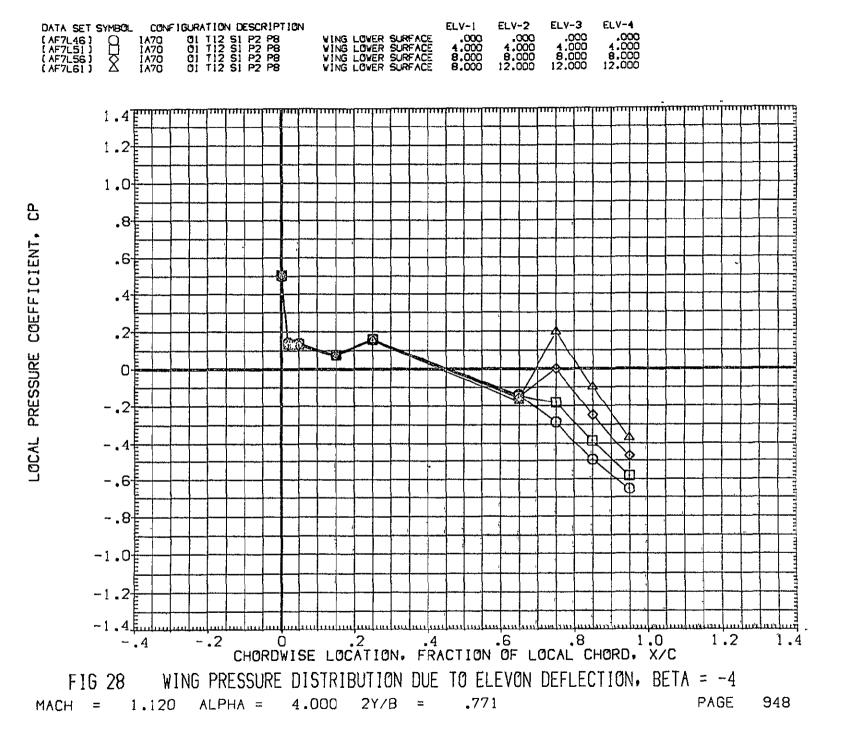


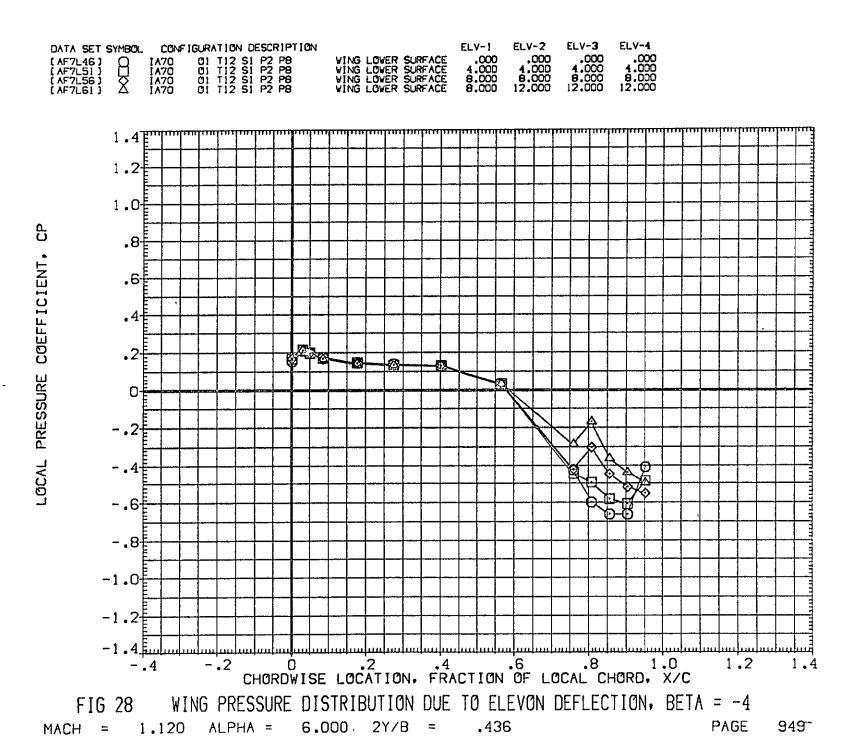


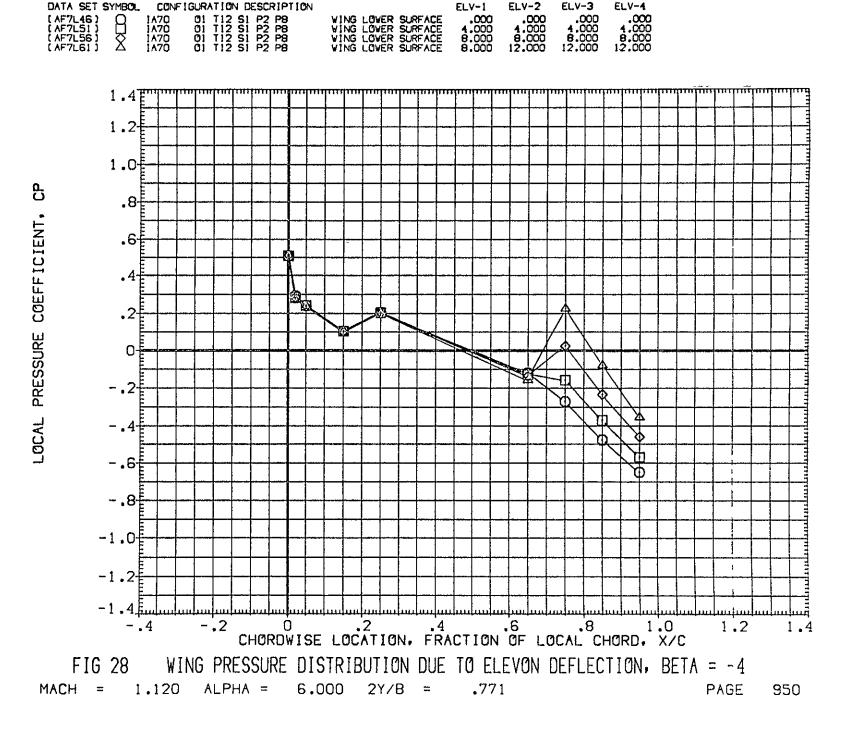


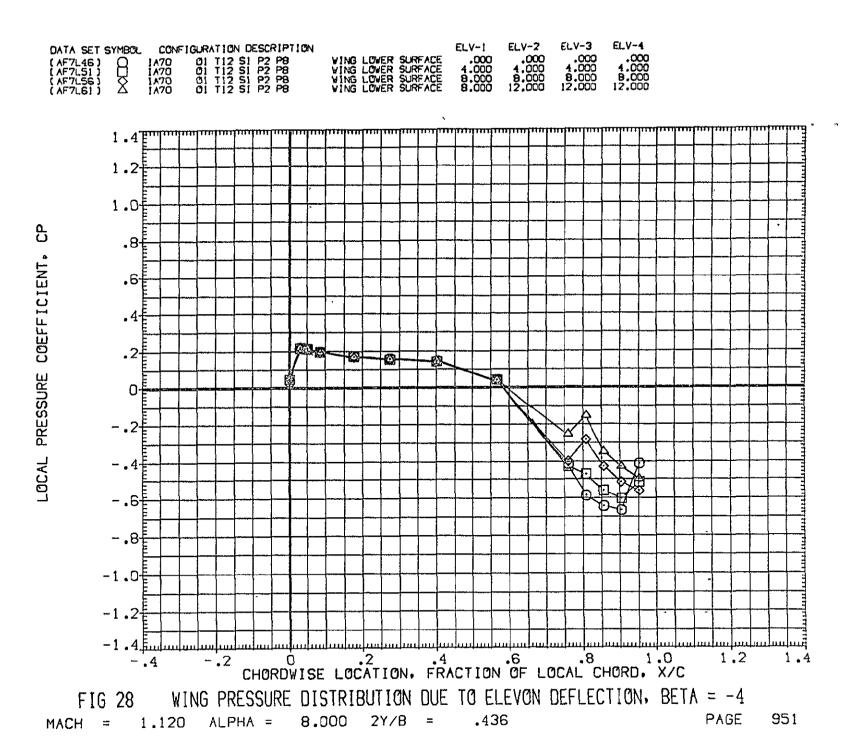


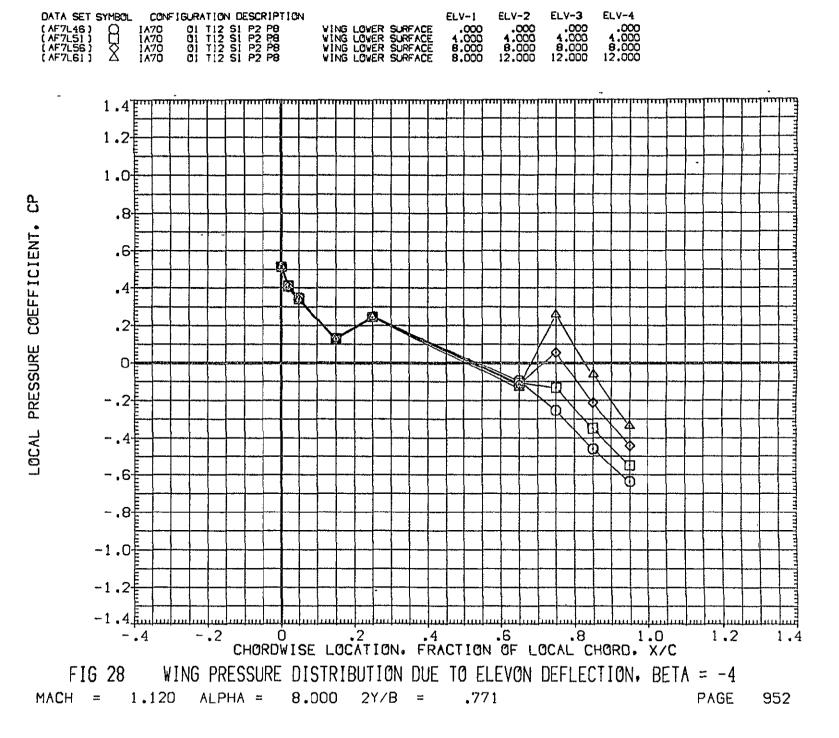


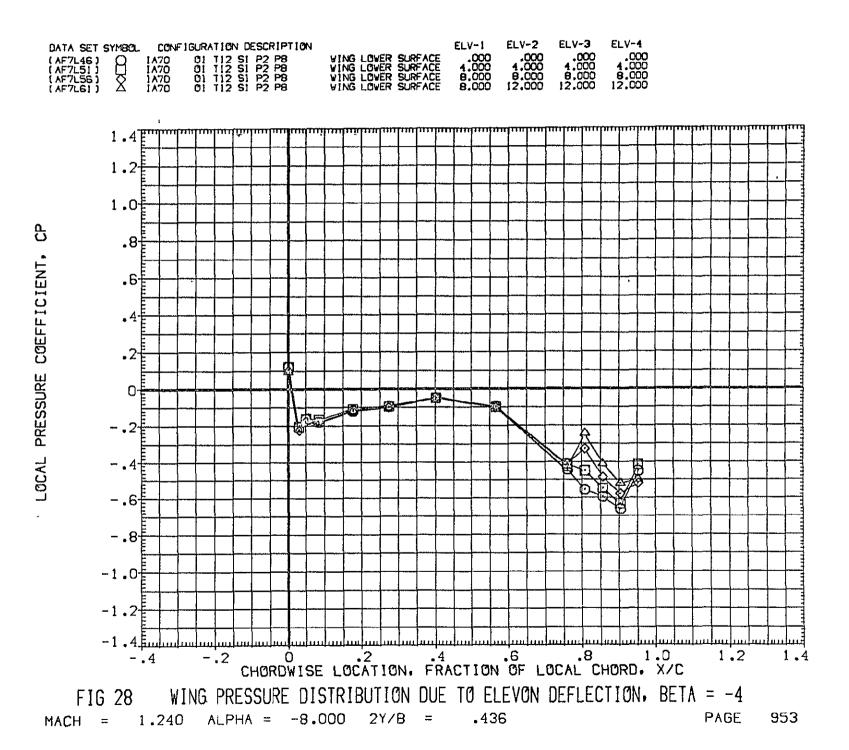


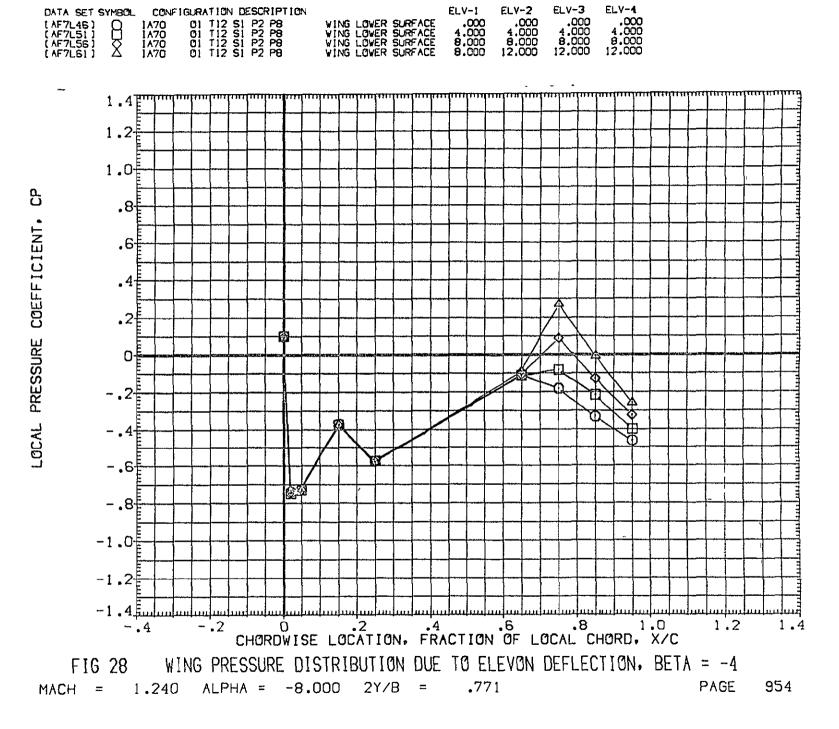


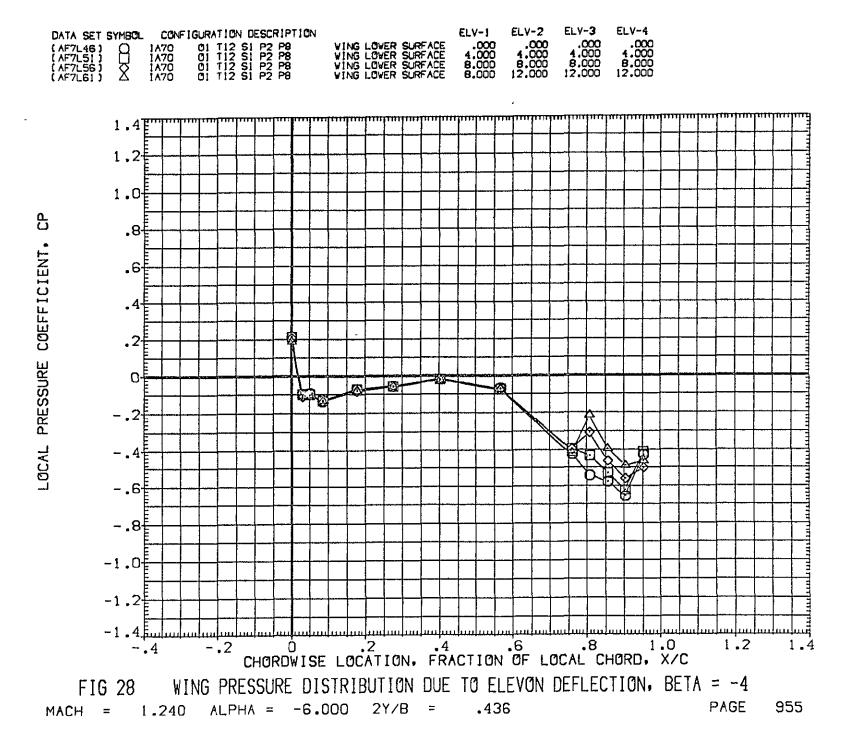


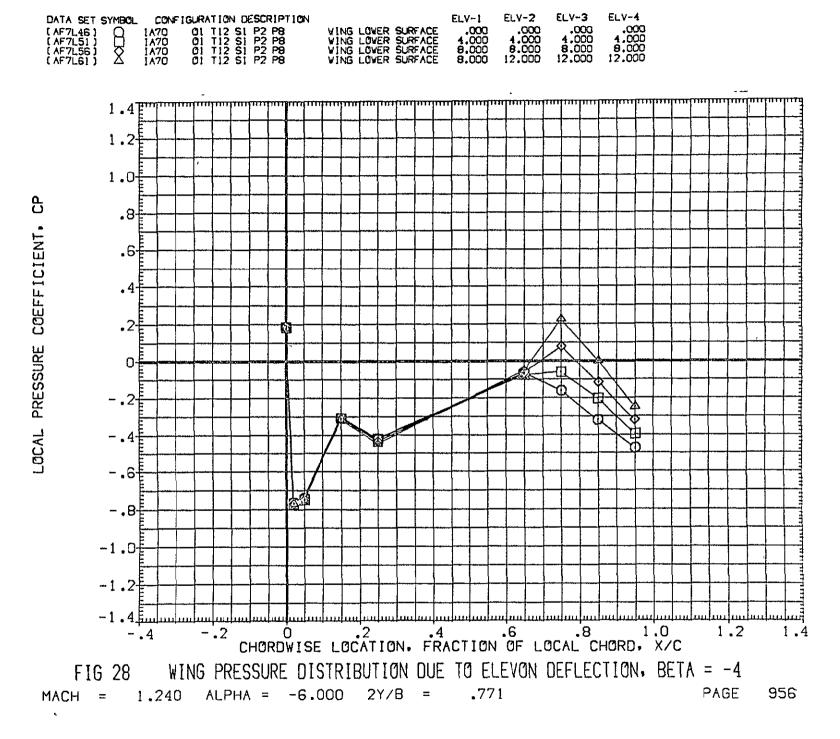


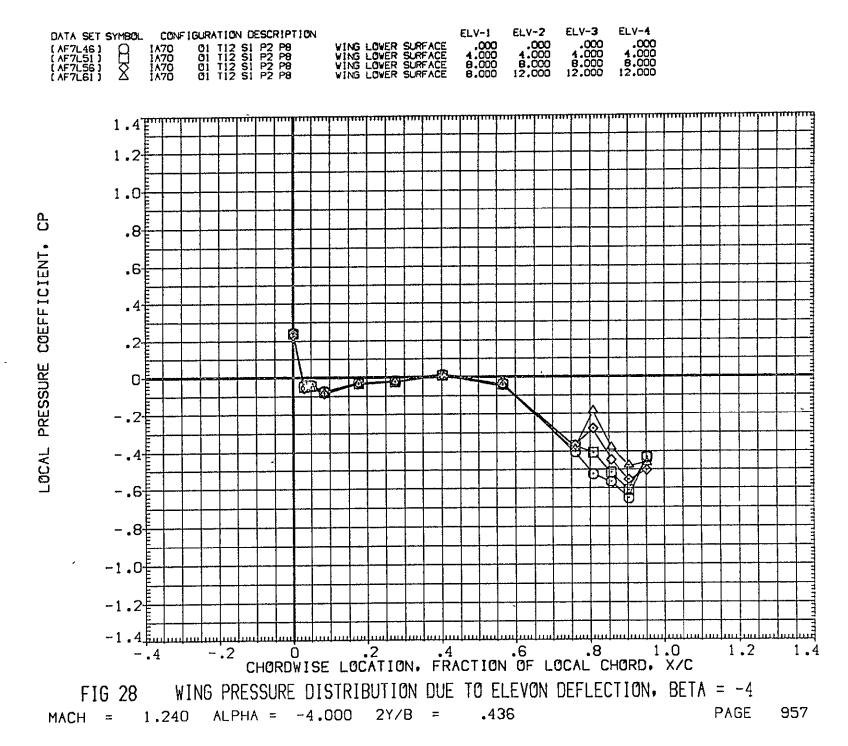


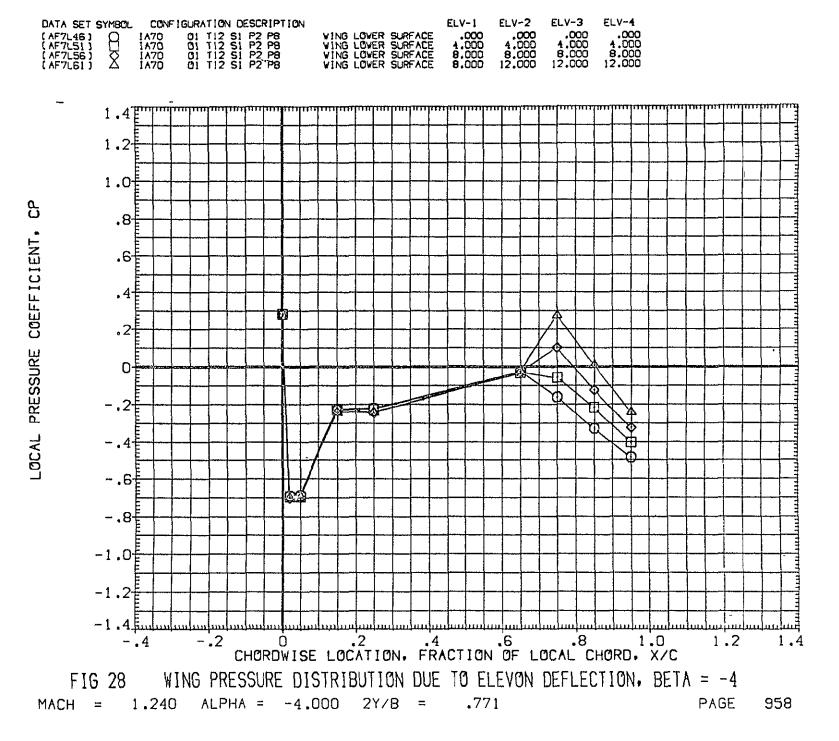


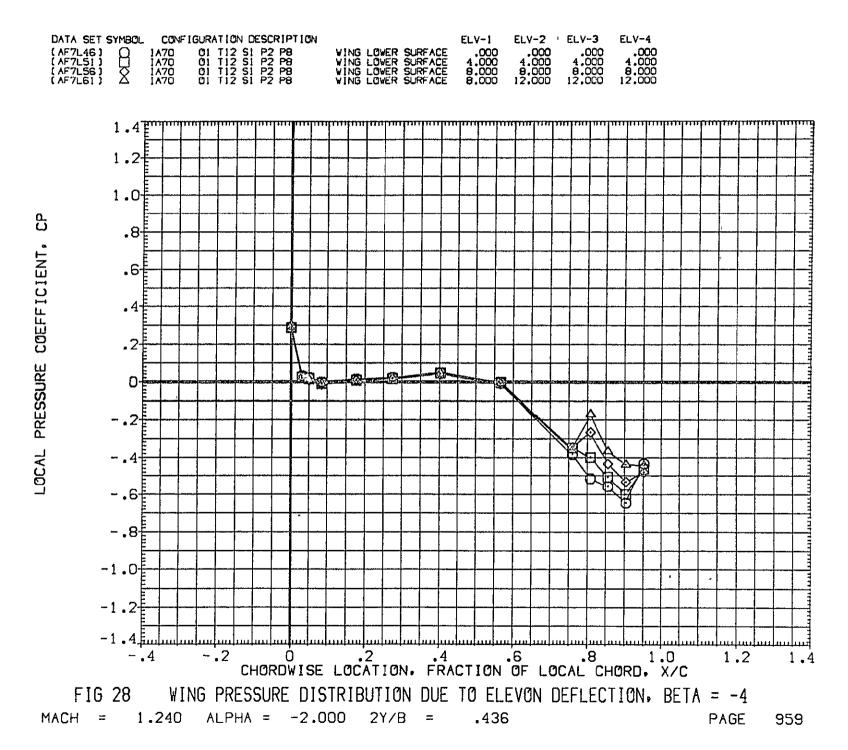


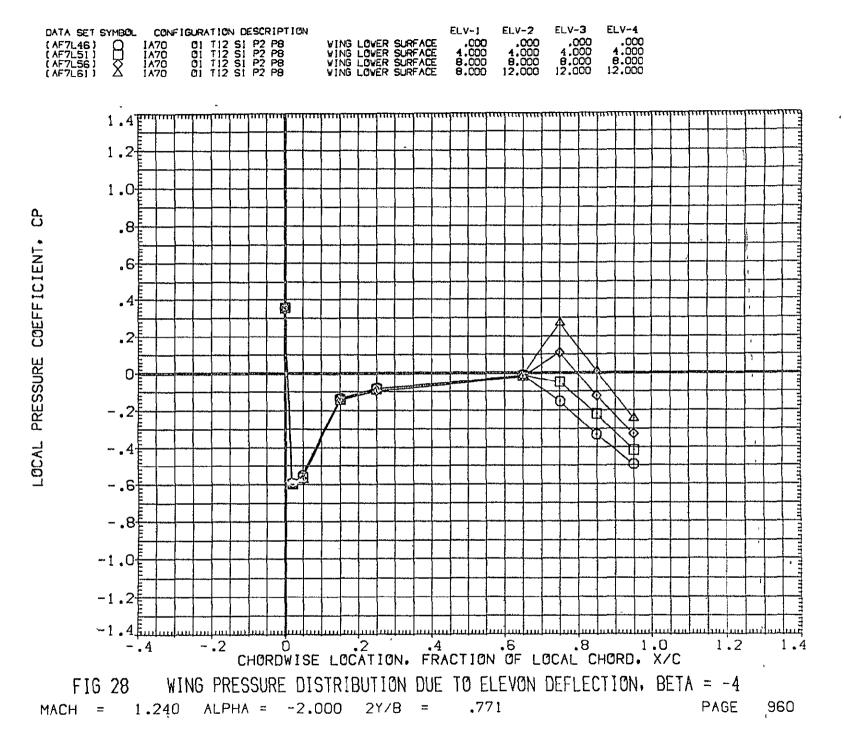


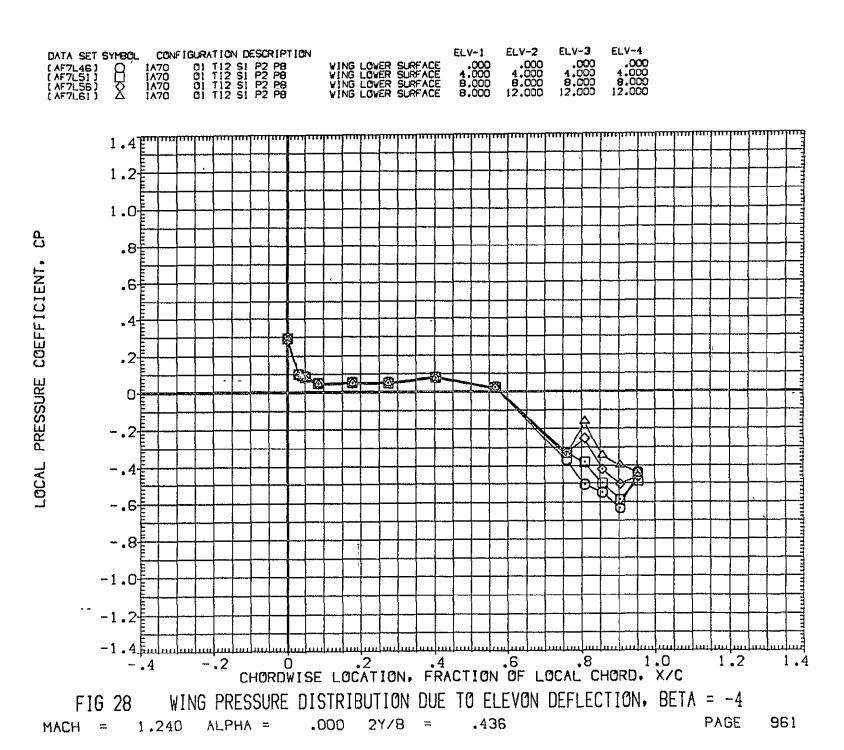


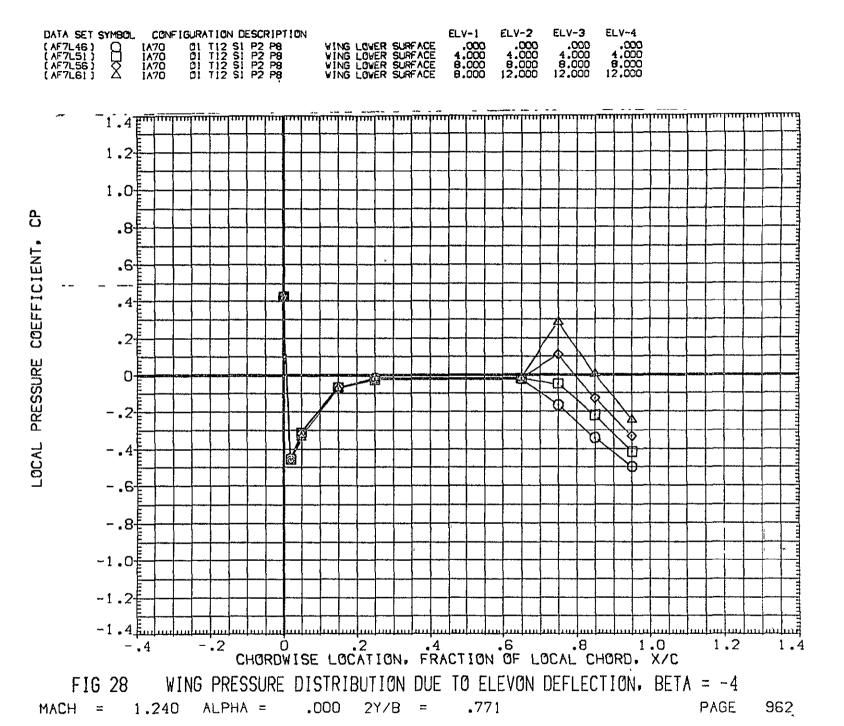


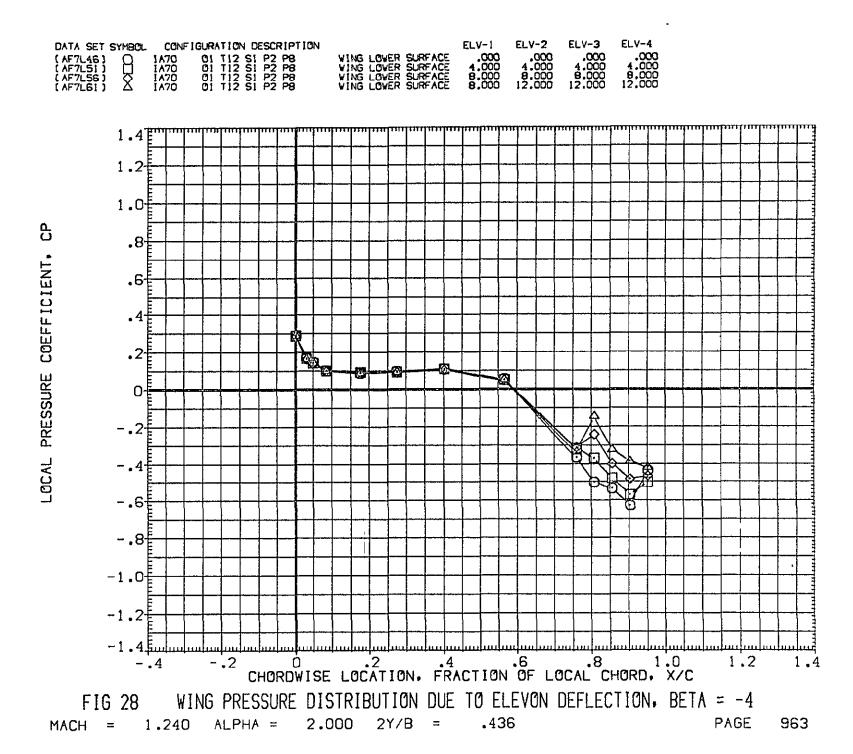


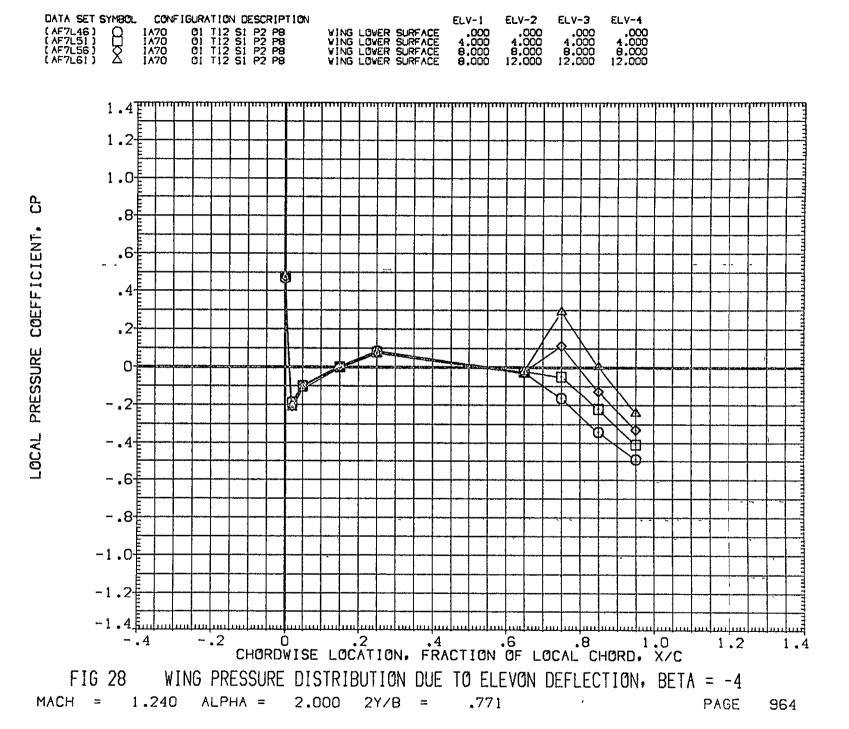


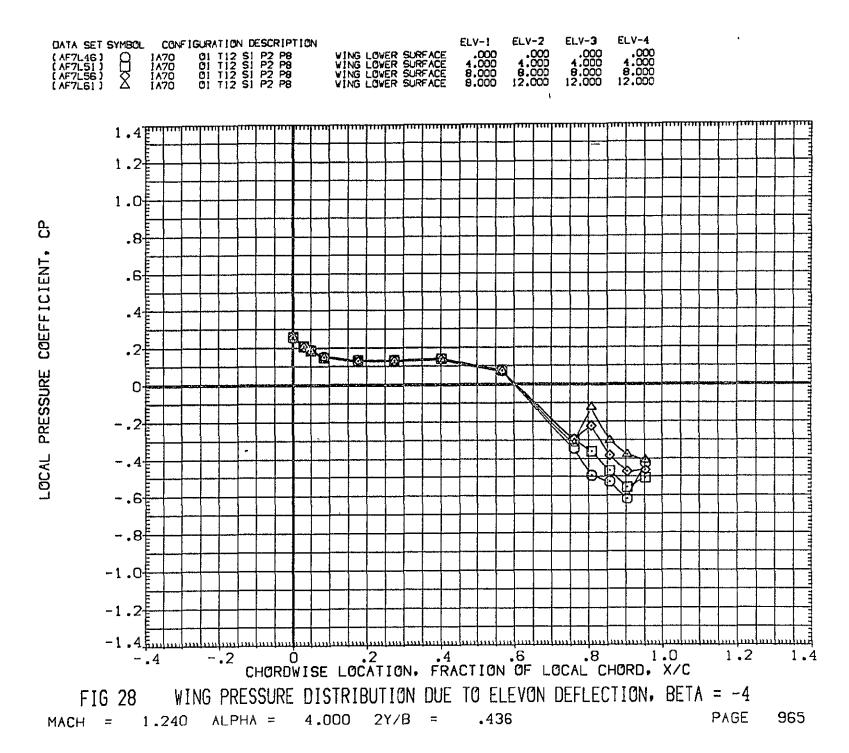




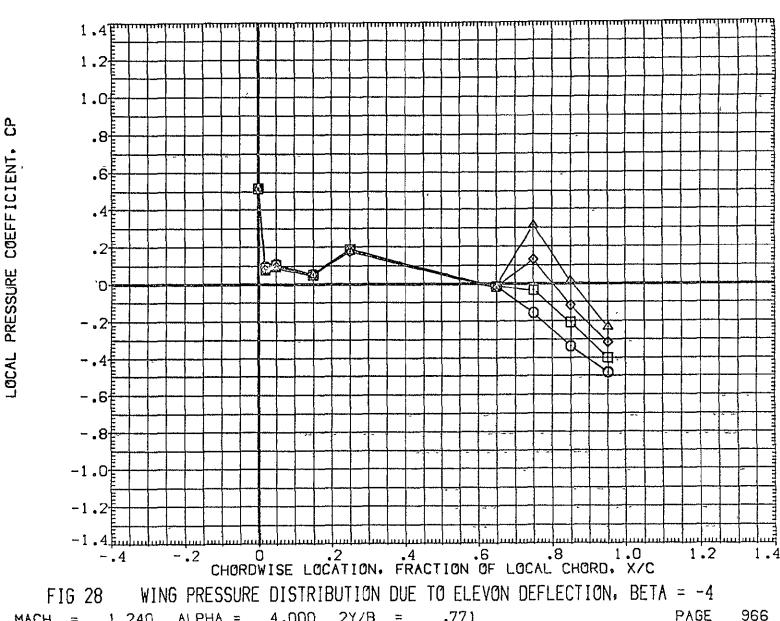




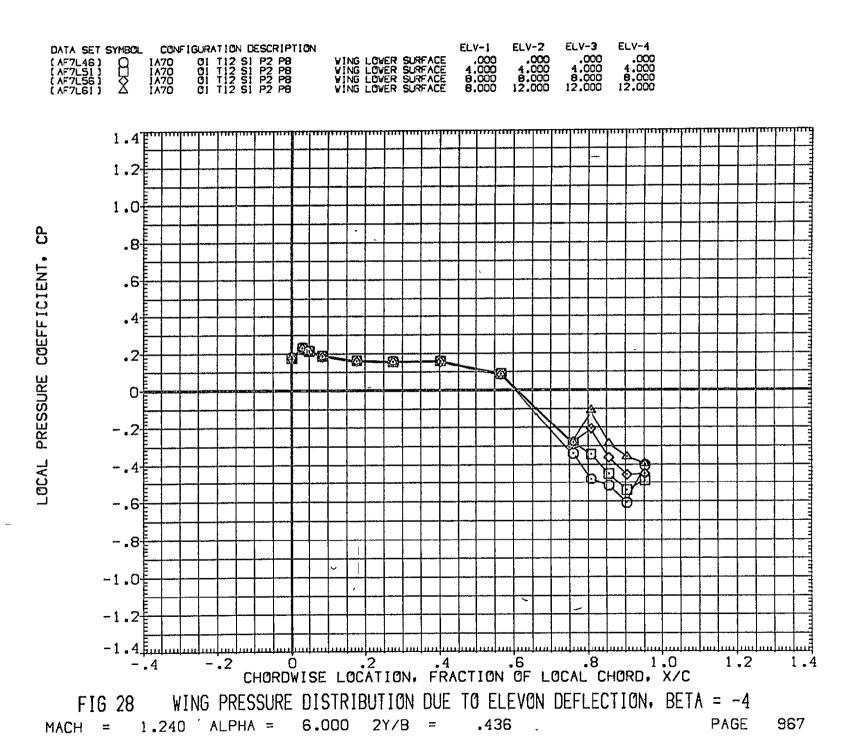


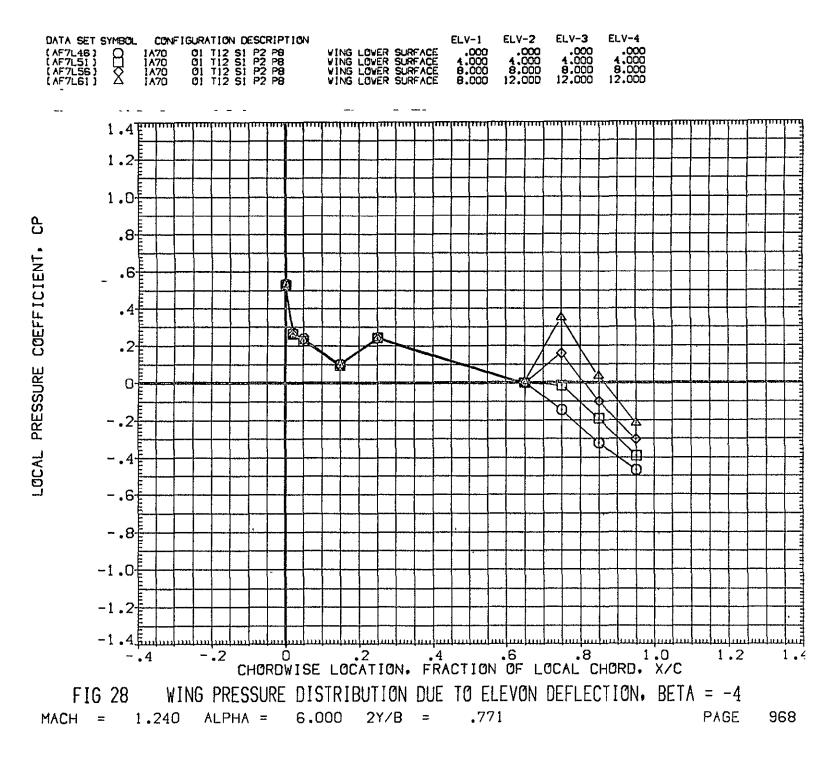


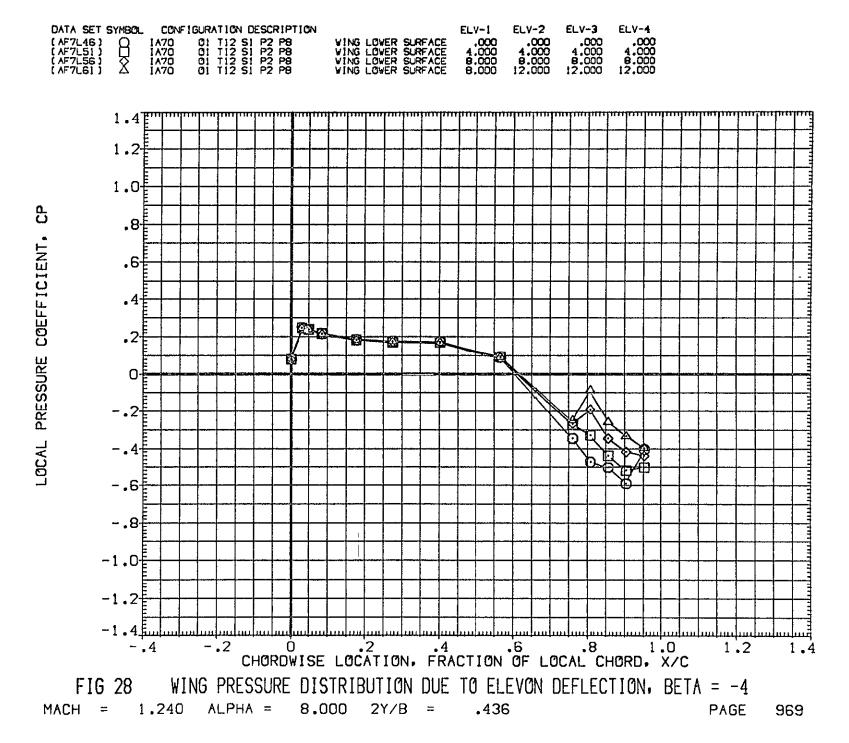


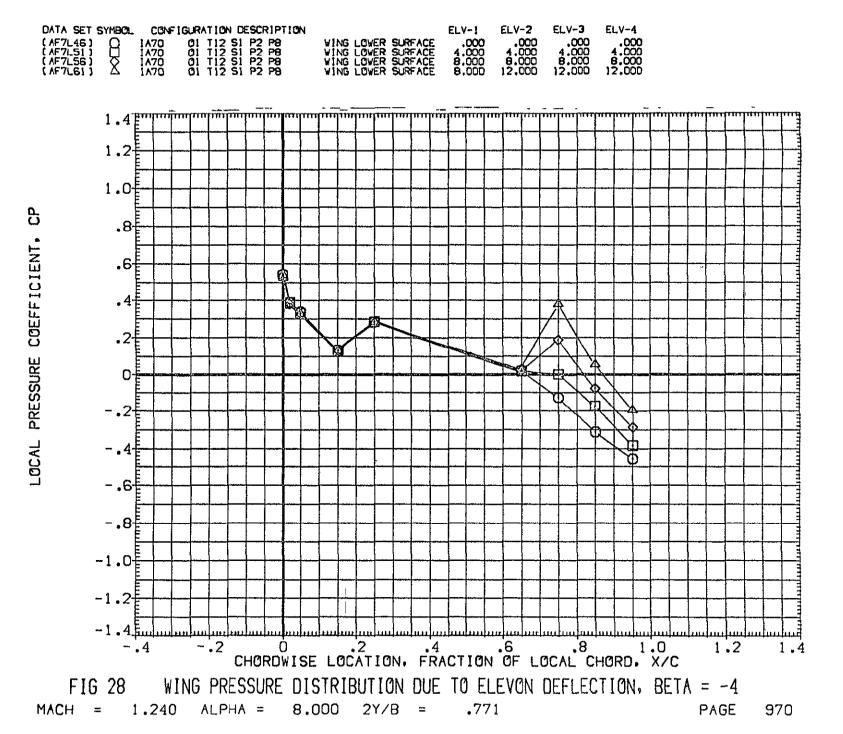


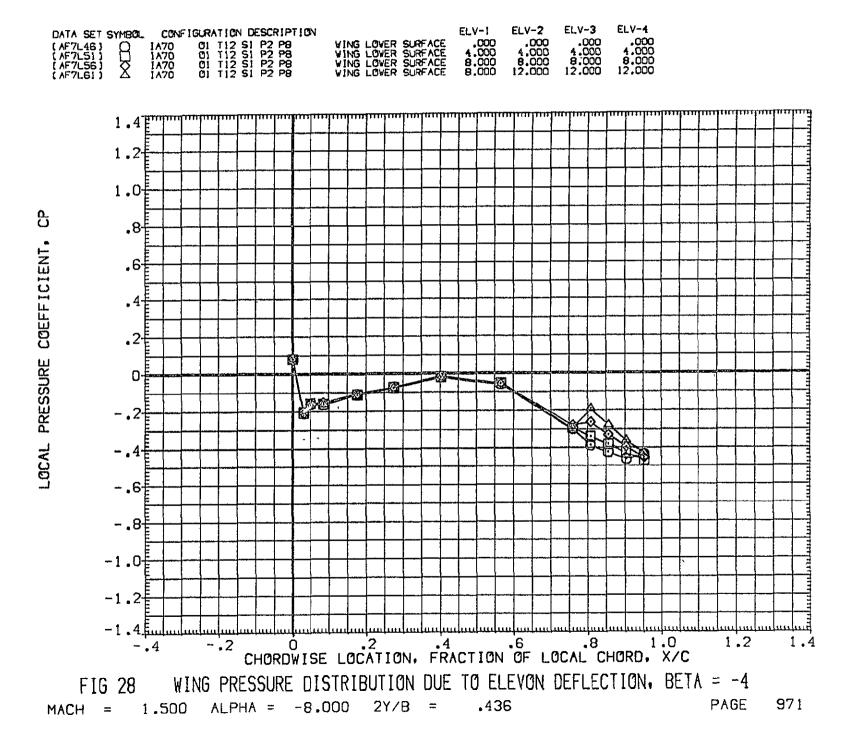
PAGE MACH = 1.240 ALPHA = 4.000 2Y/B = .771

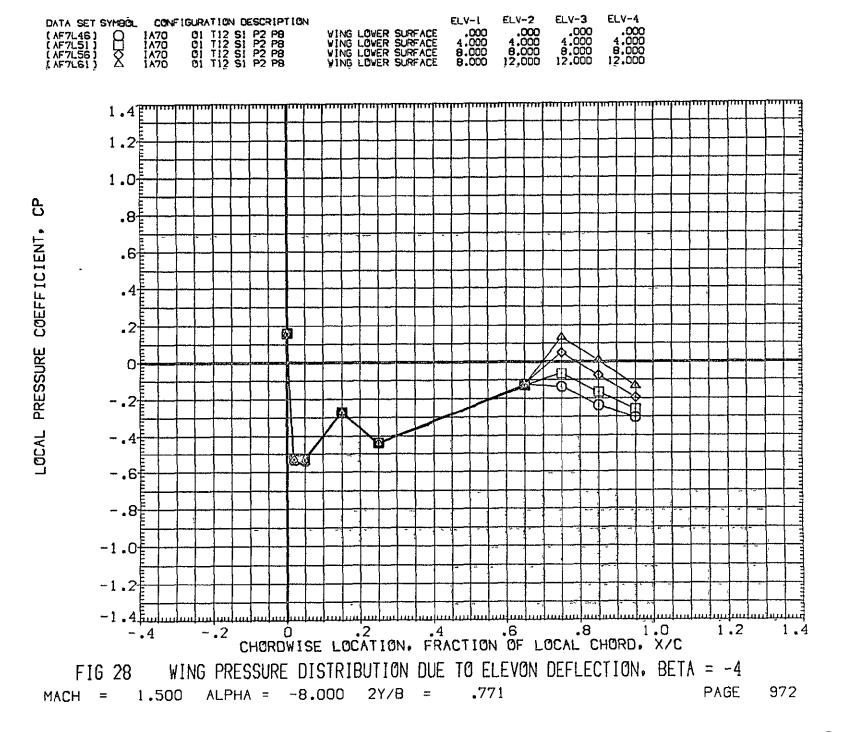


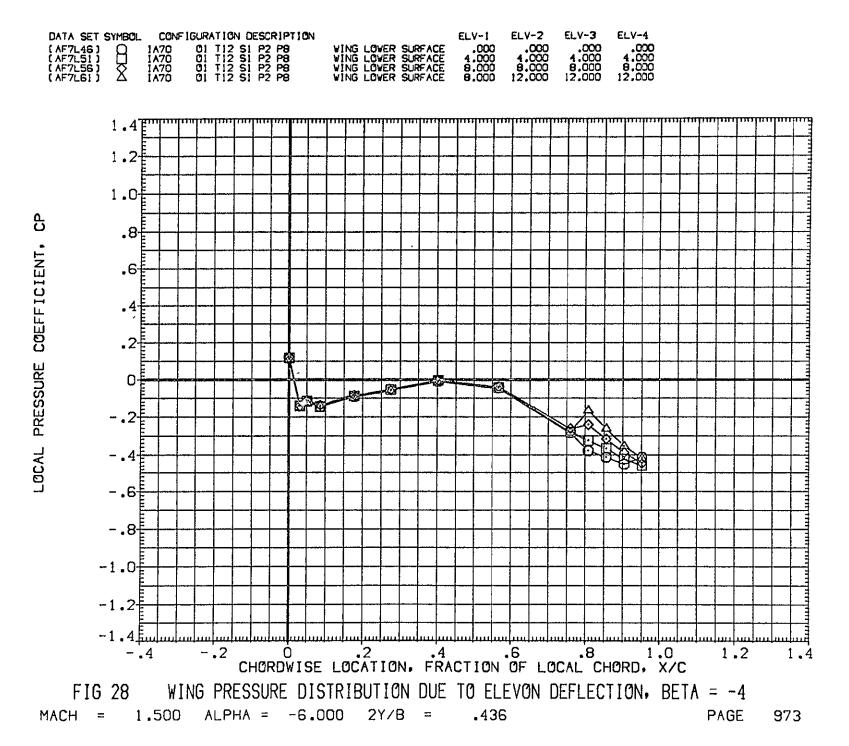


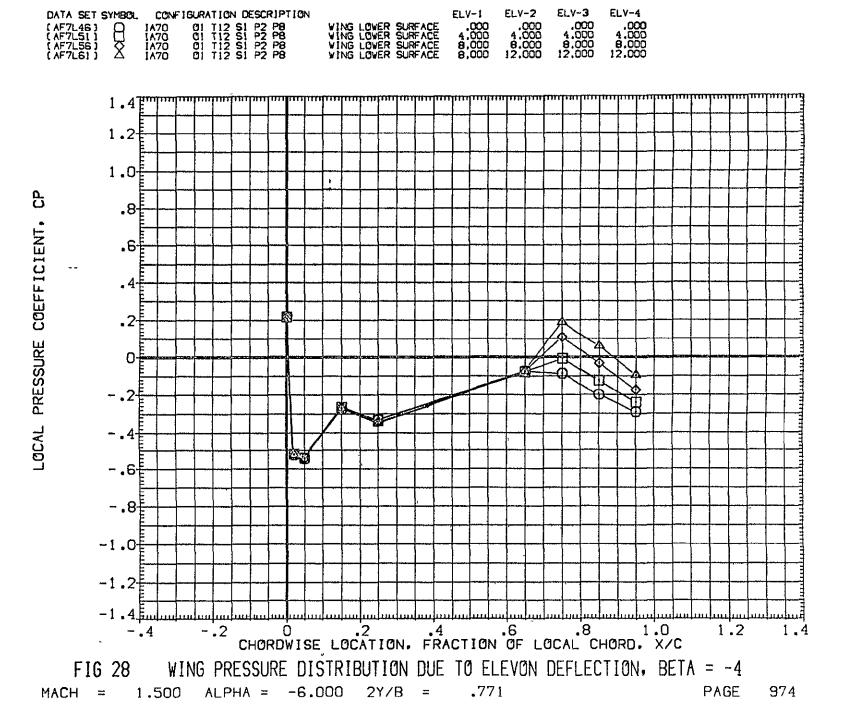


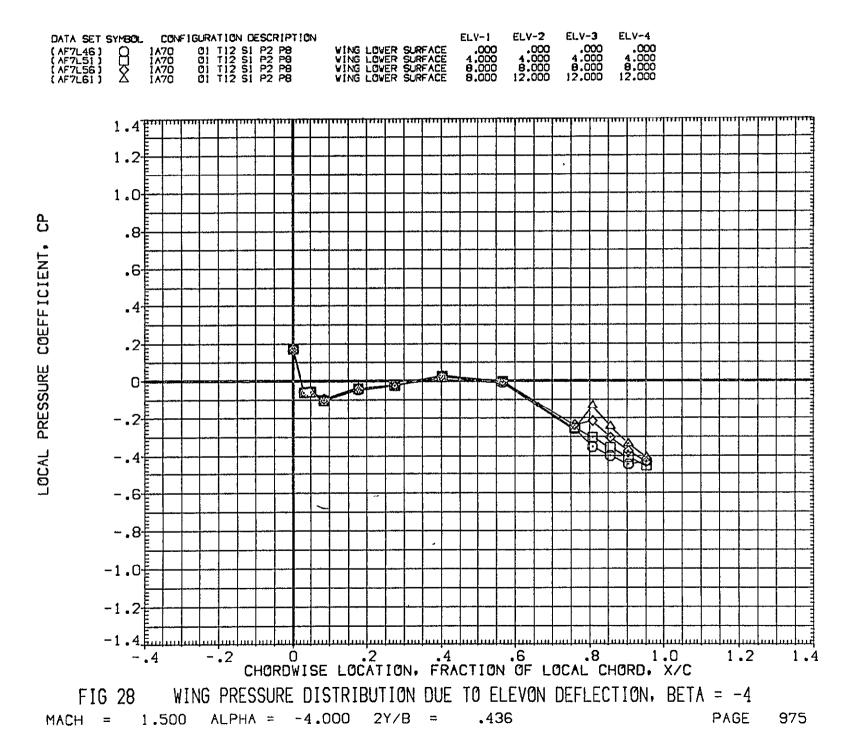


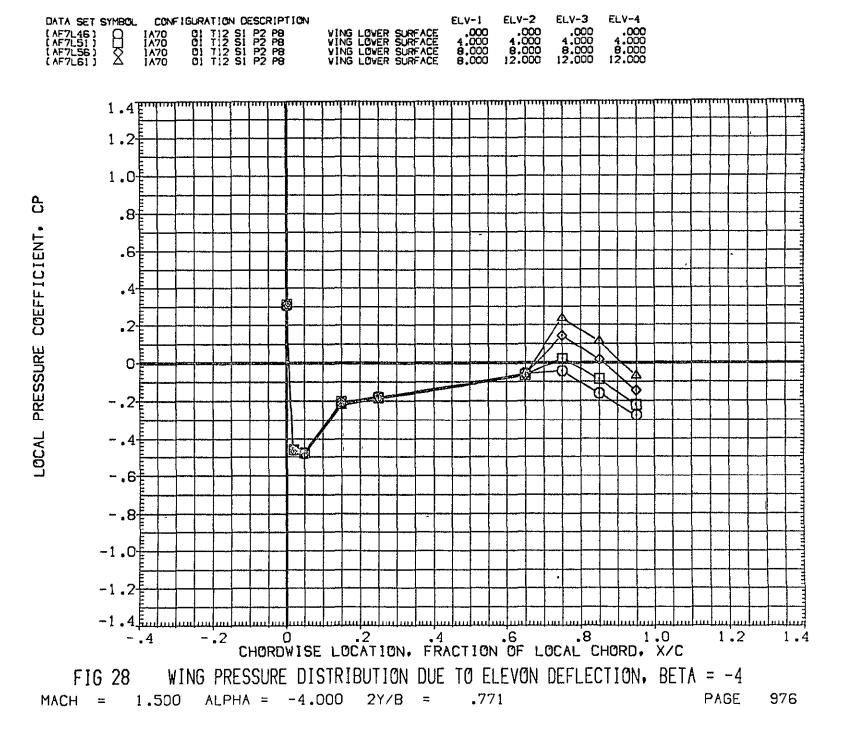


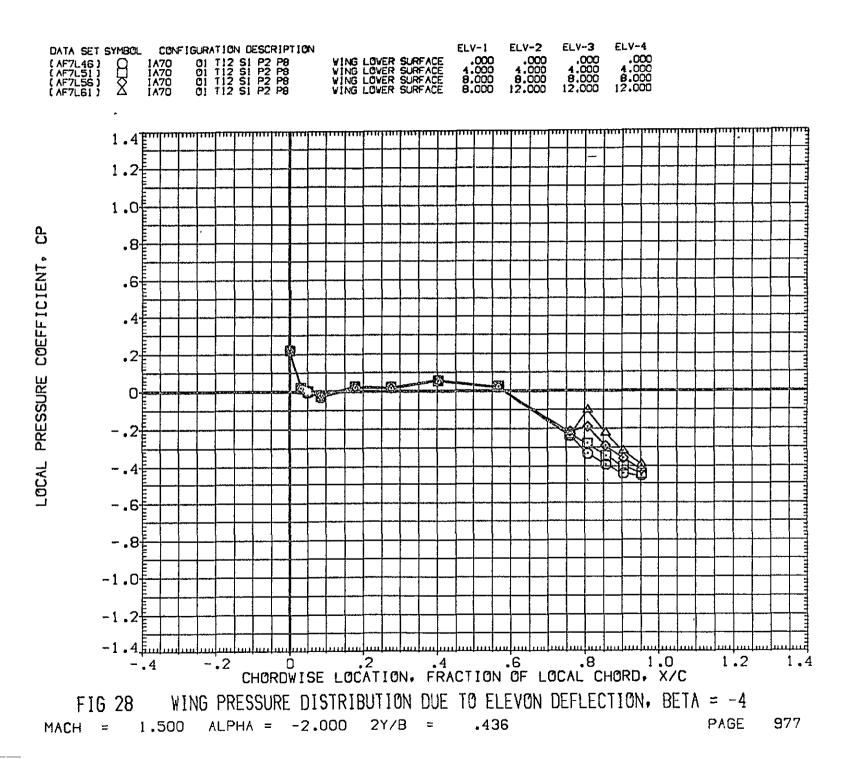












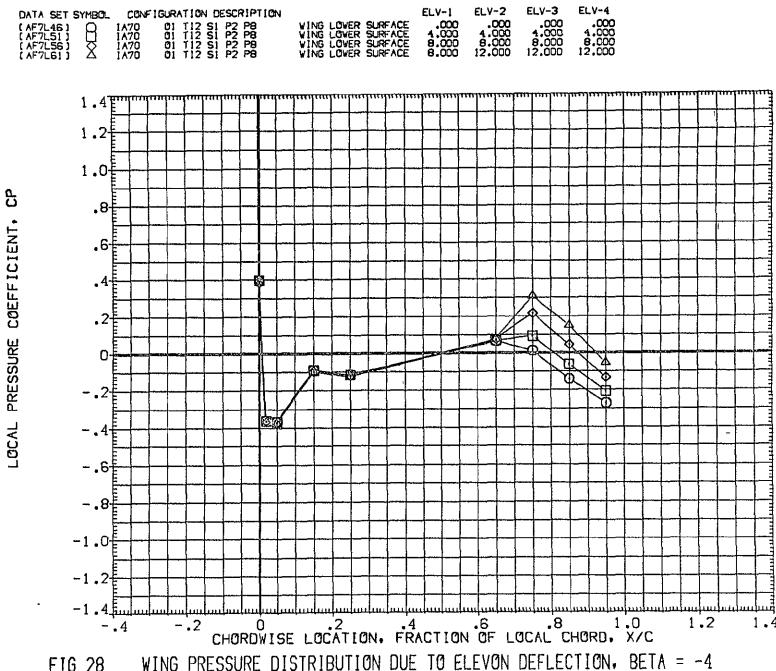
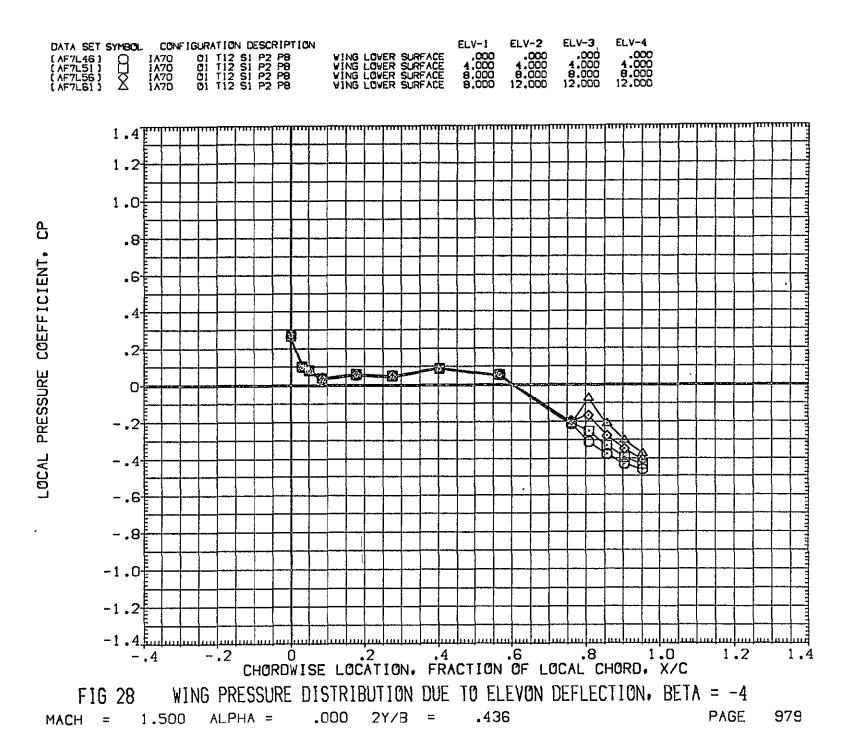
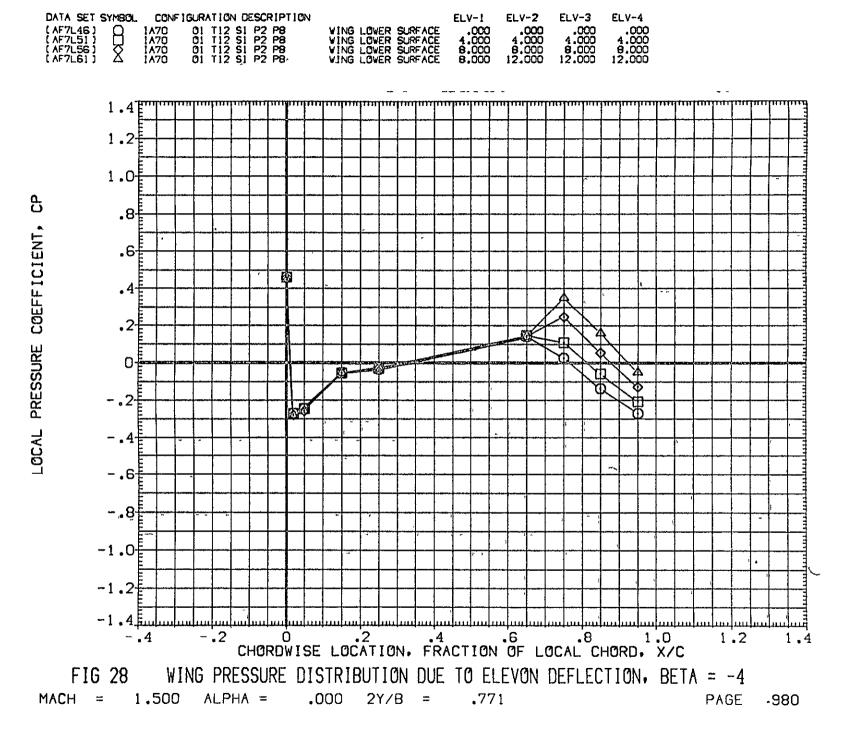
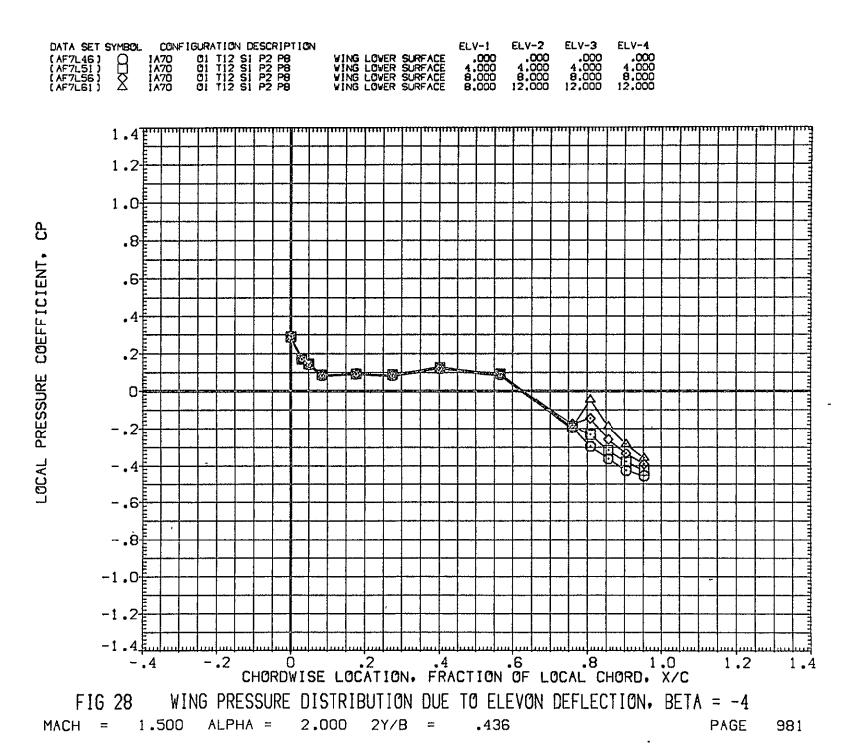


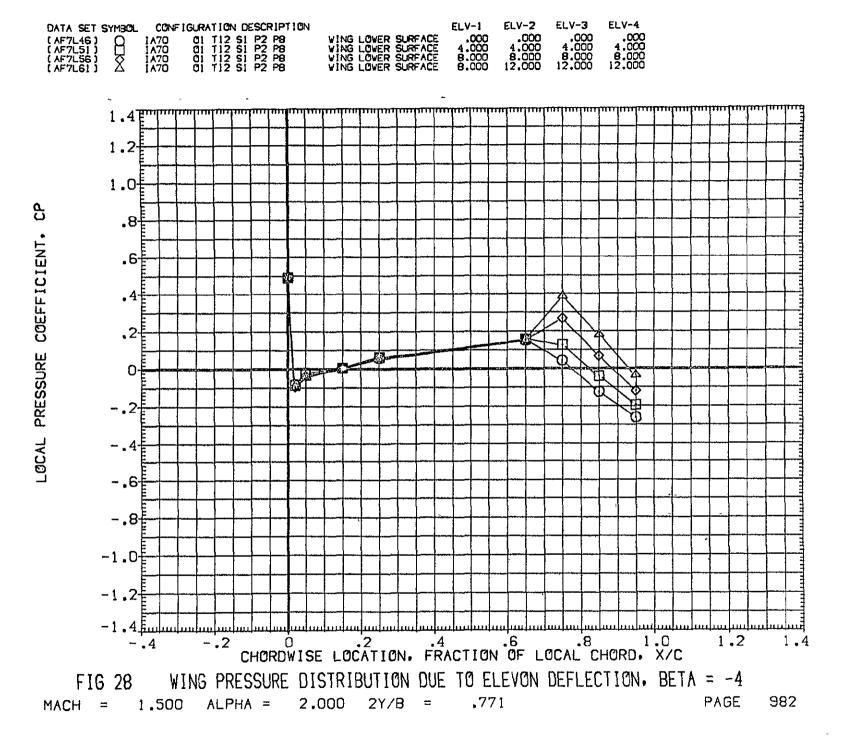
FIG 28 WING PRESSURE DISTRIBUTION DUE TO ELEVON DEFLECTION, BETA = -4

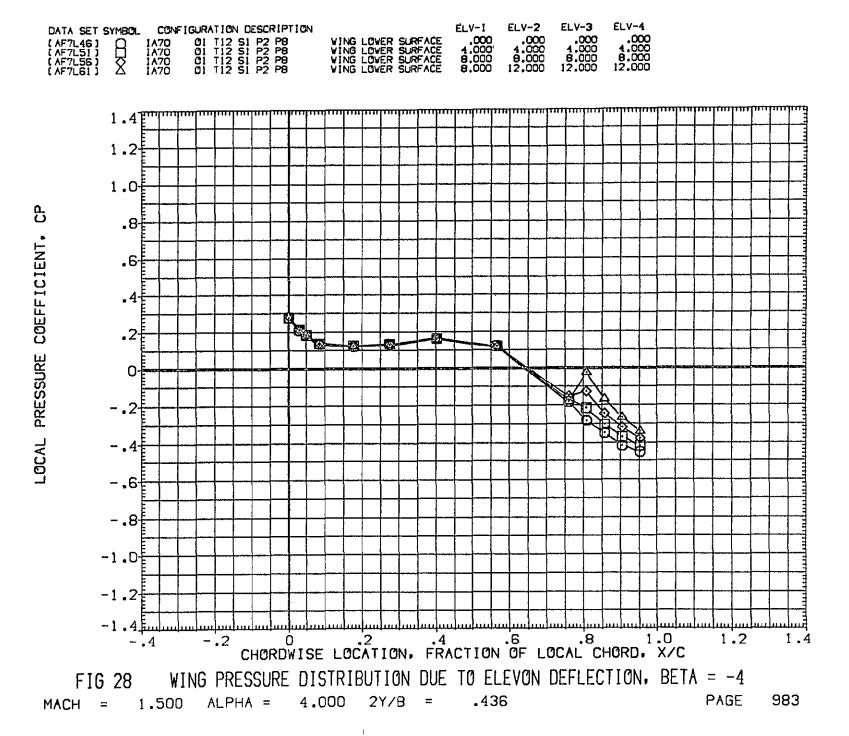
MACH = 1.500 ALPHA = -2.000 2Y/B = .771 PAGE 978

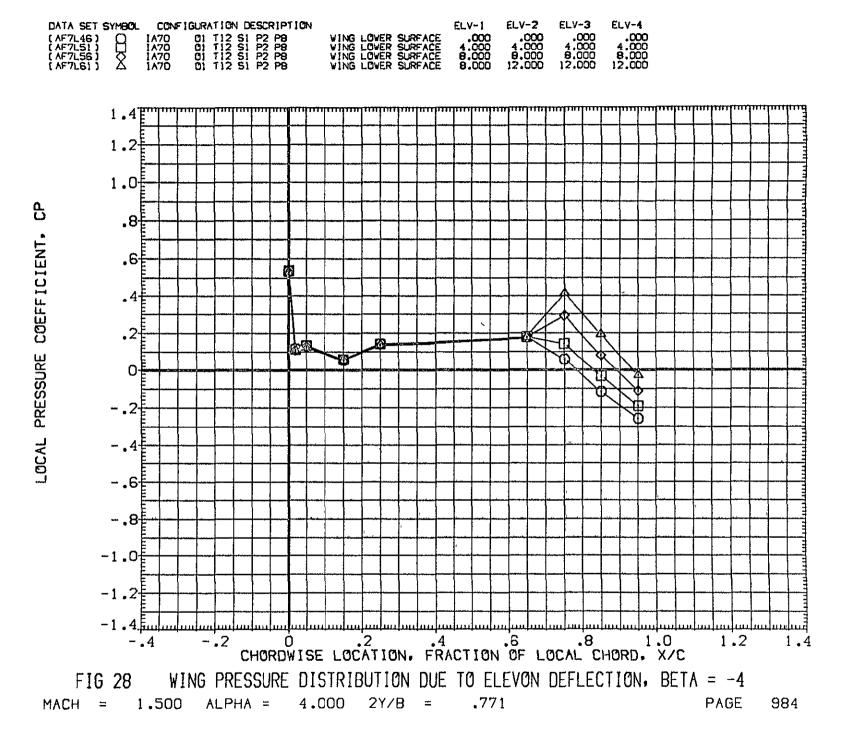


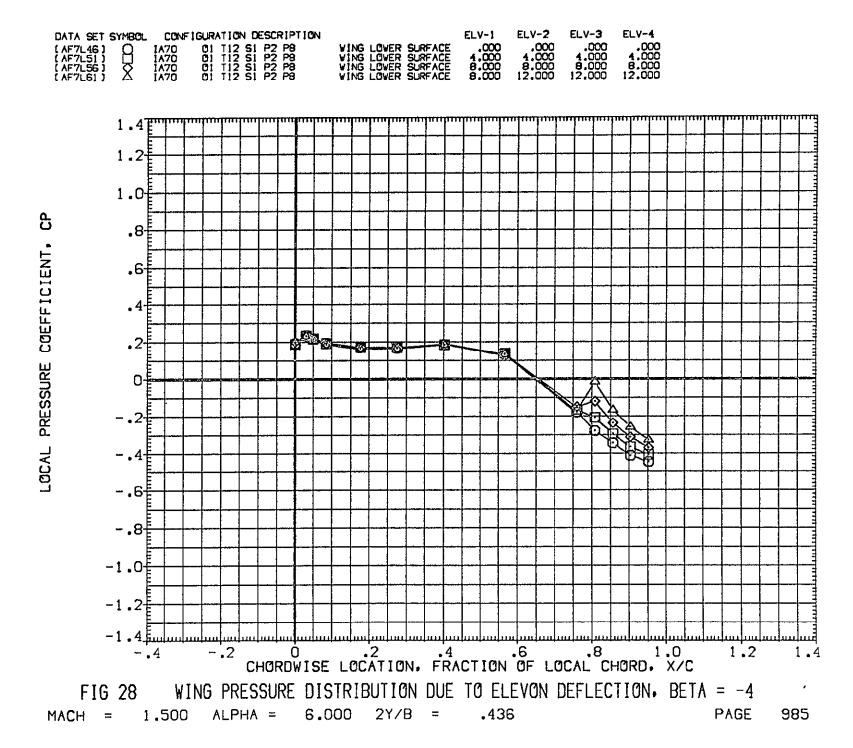


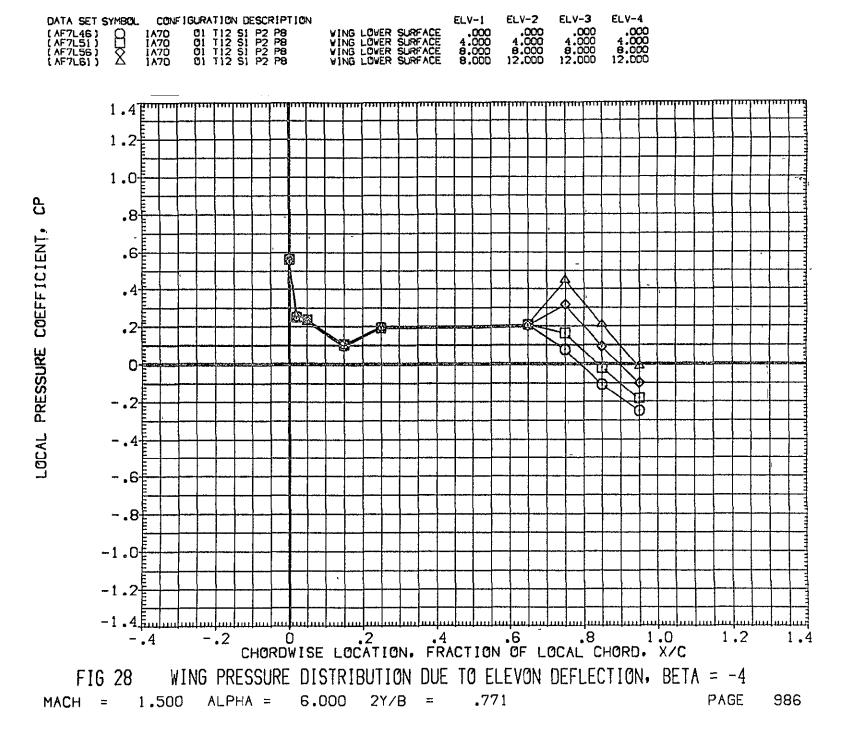


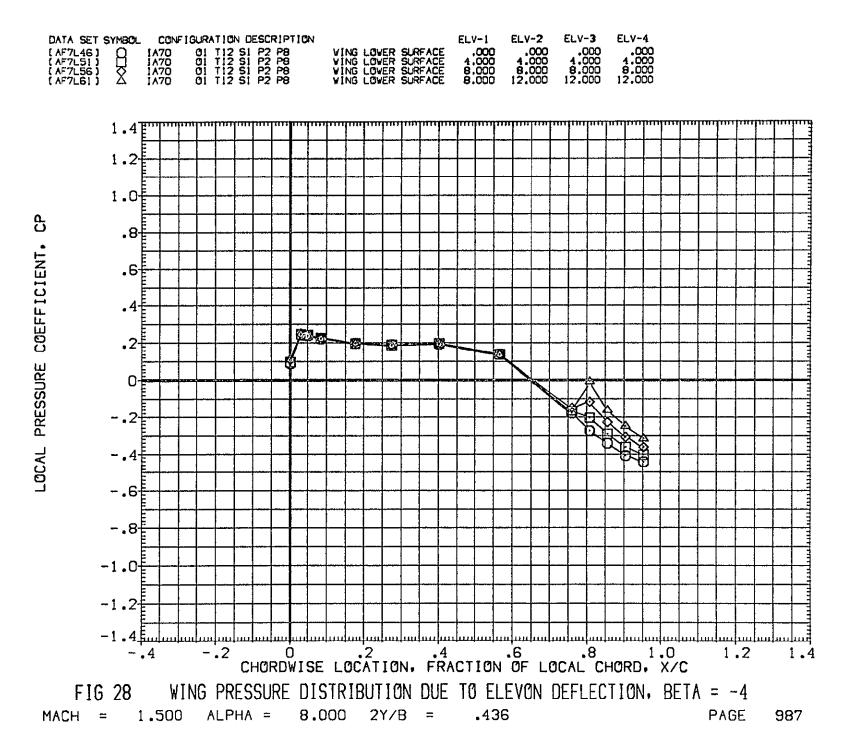


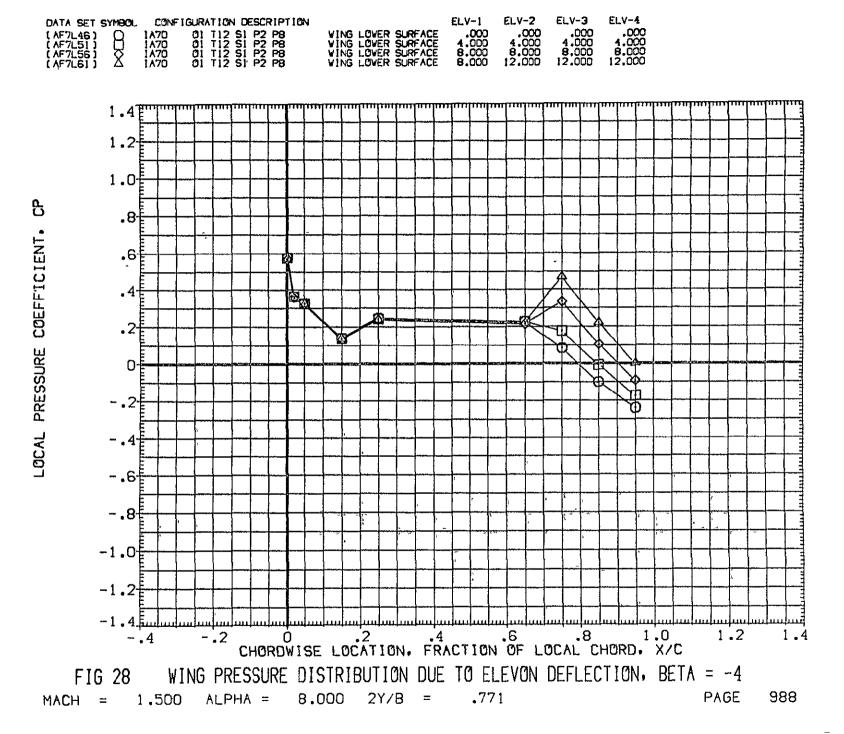


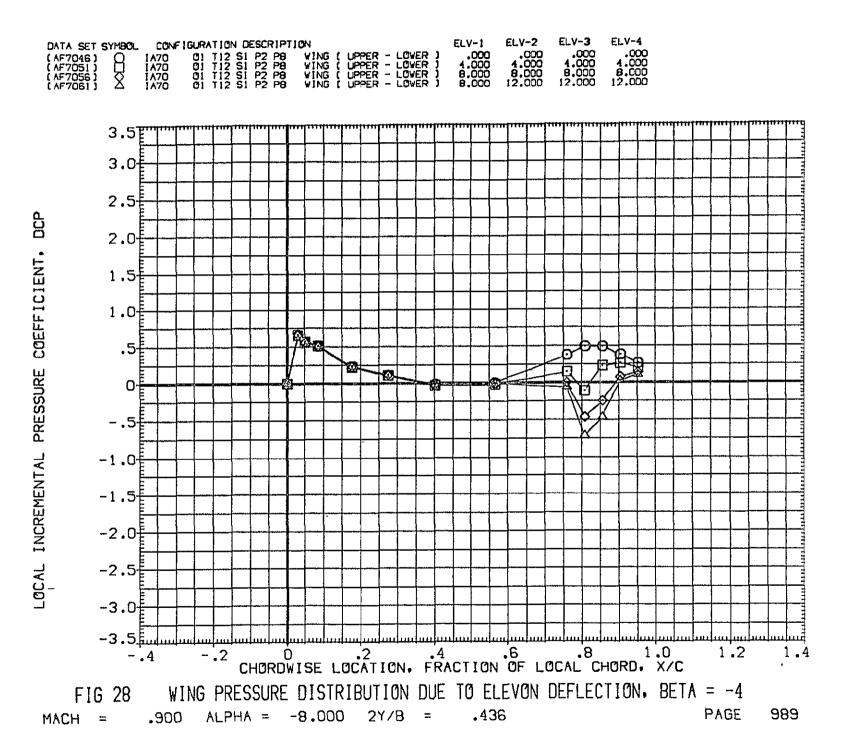


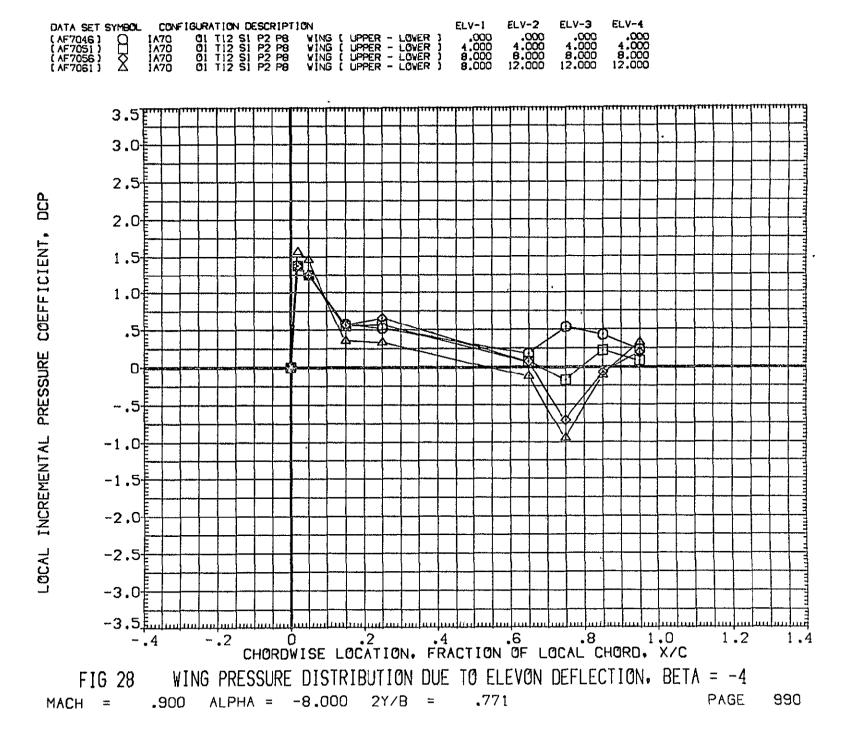


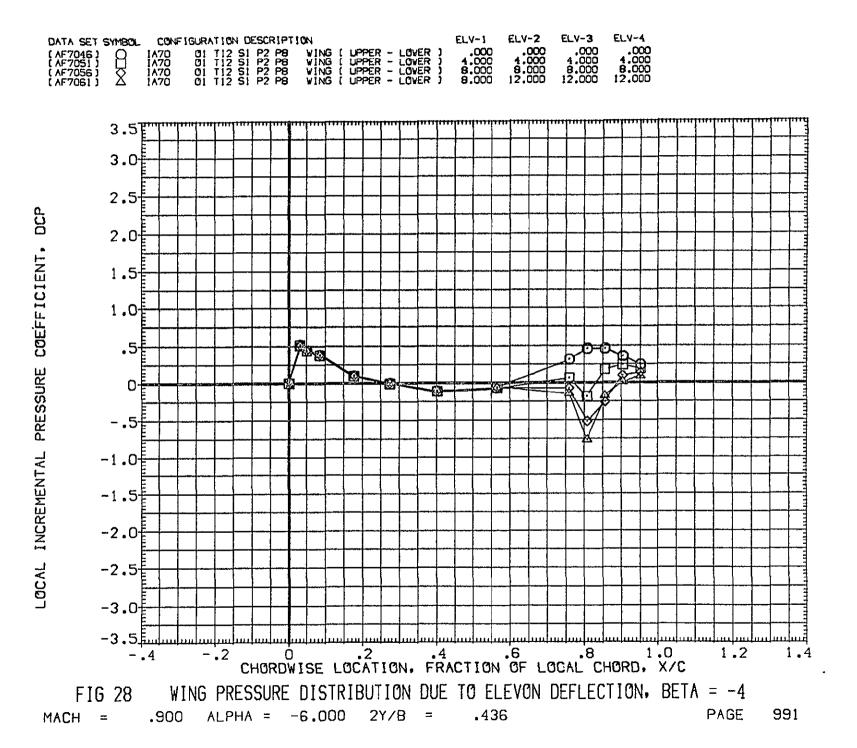


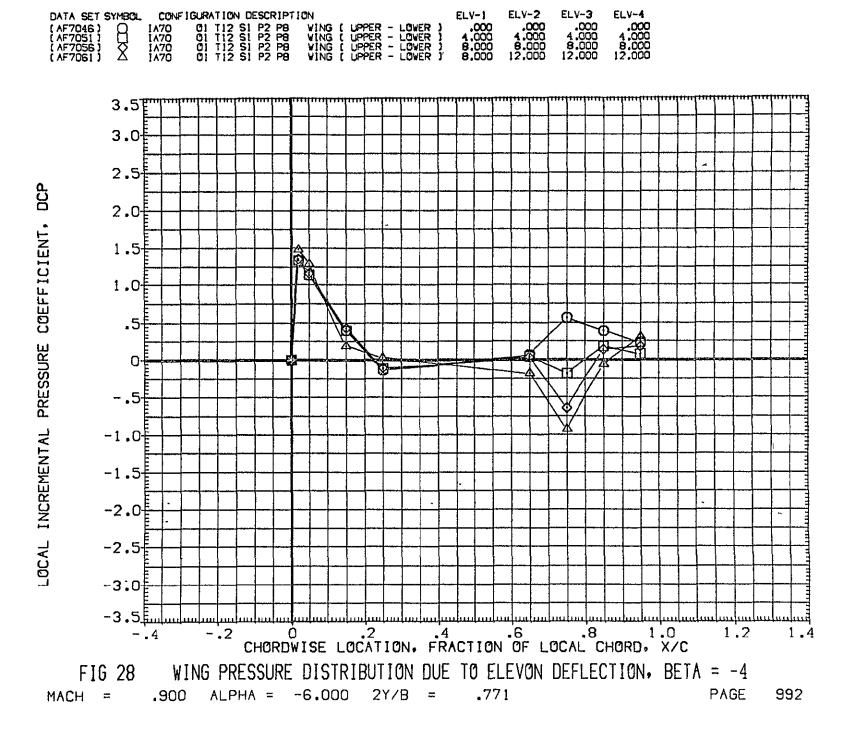


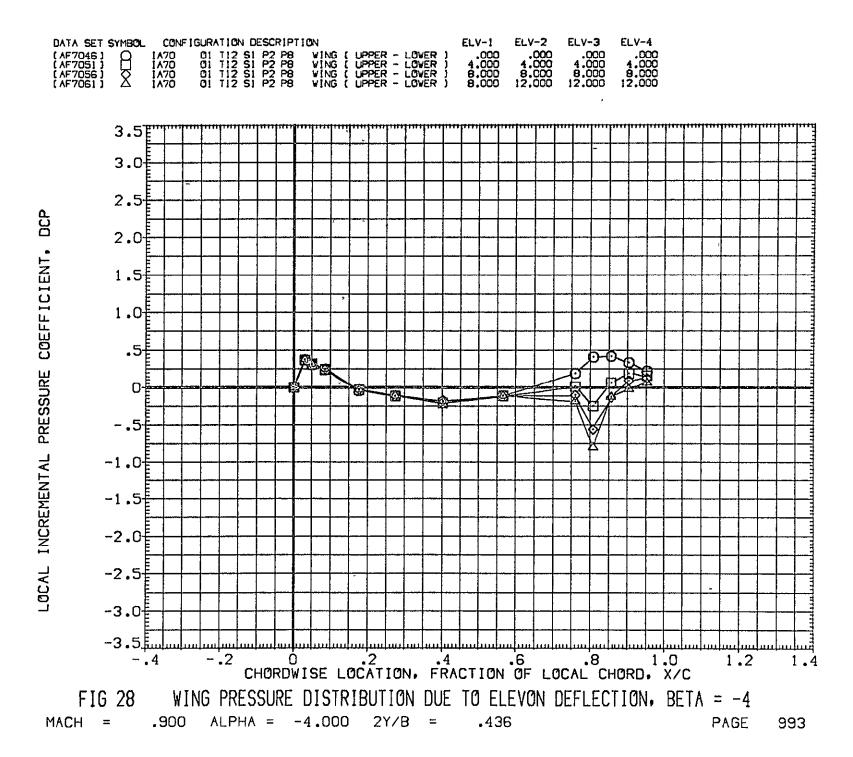


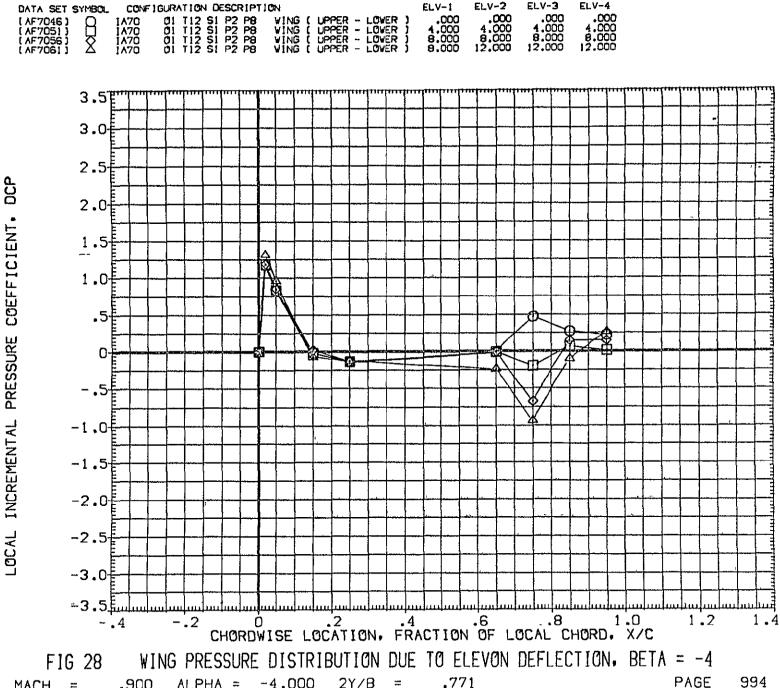










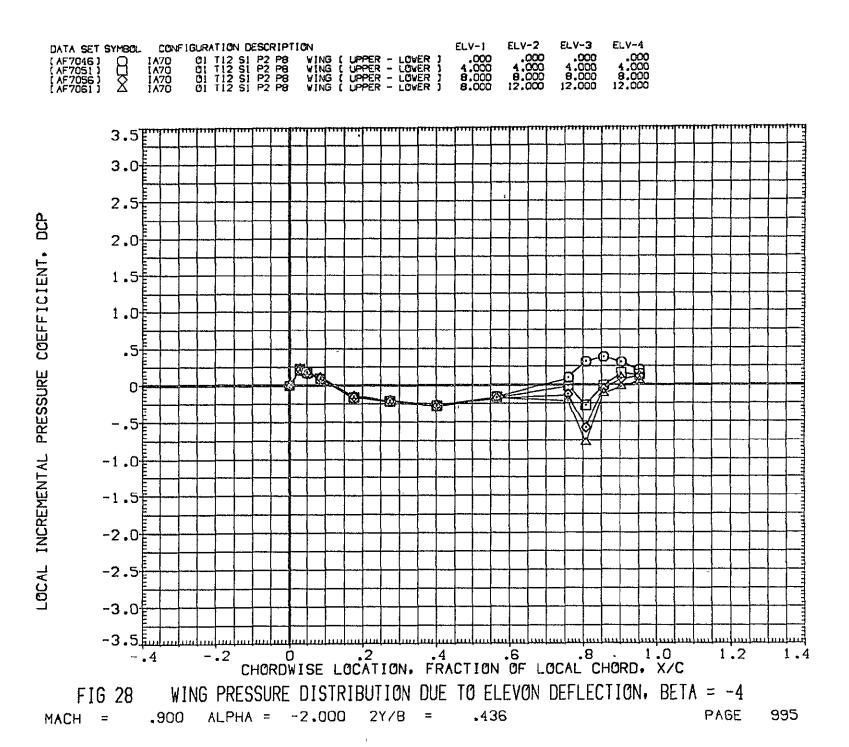


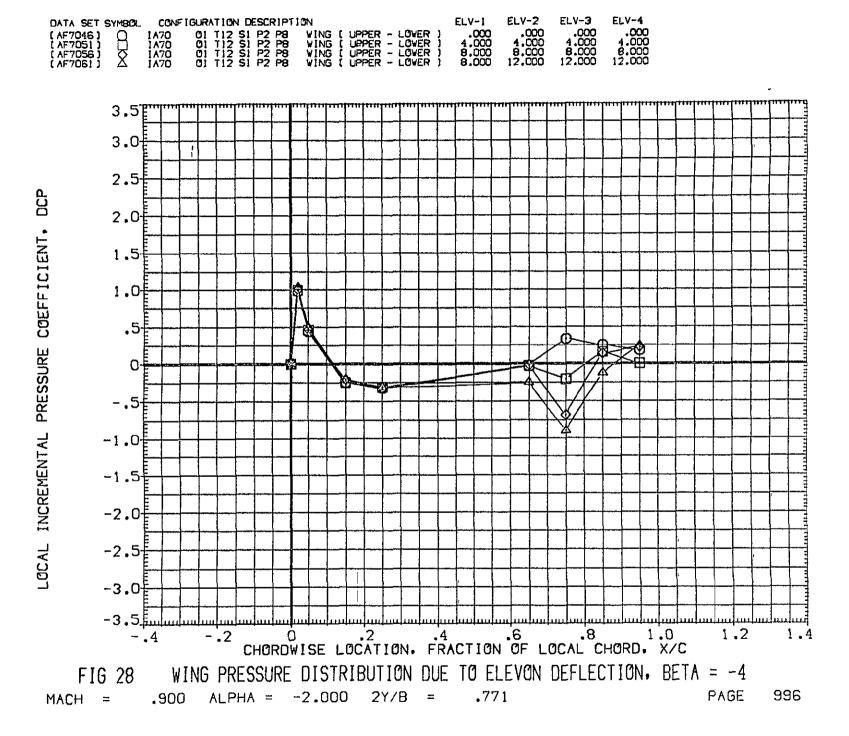
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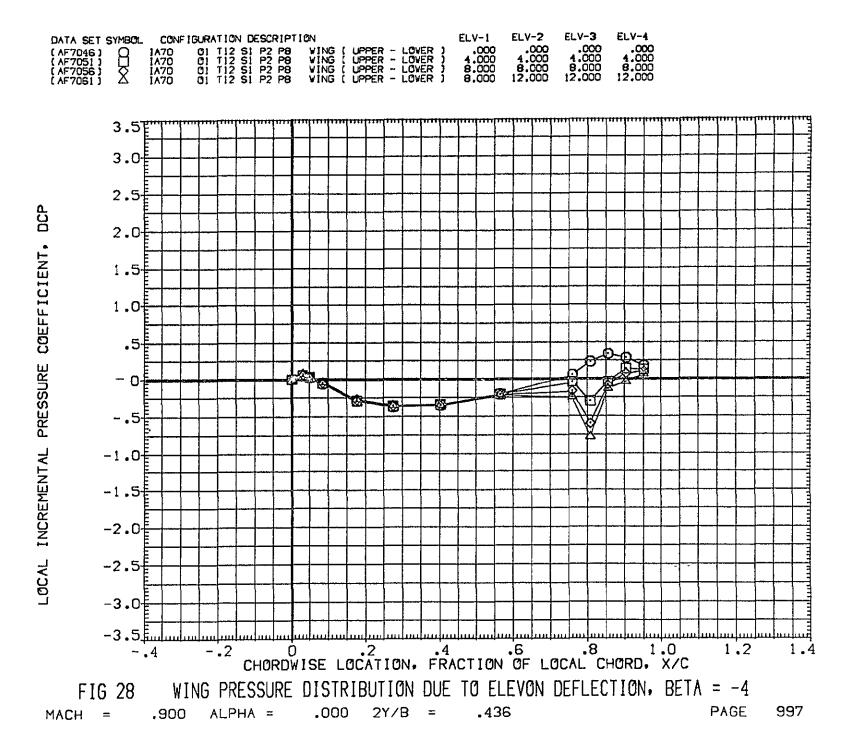
ELV-3

ELV-4

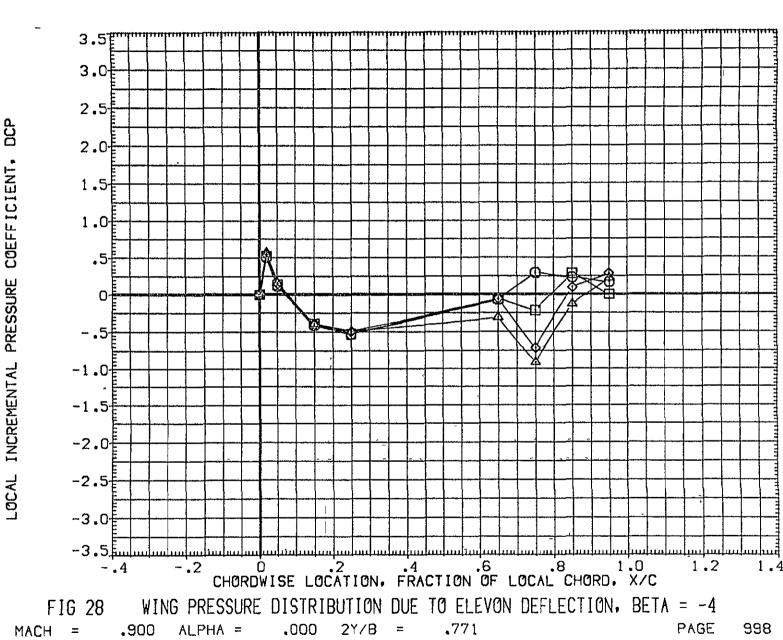
PAGE .900 ALPHA = -4.000 2Y/B = MACH = .771

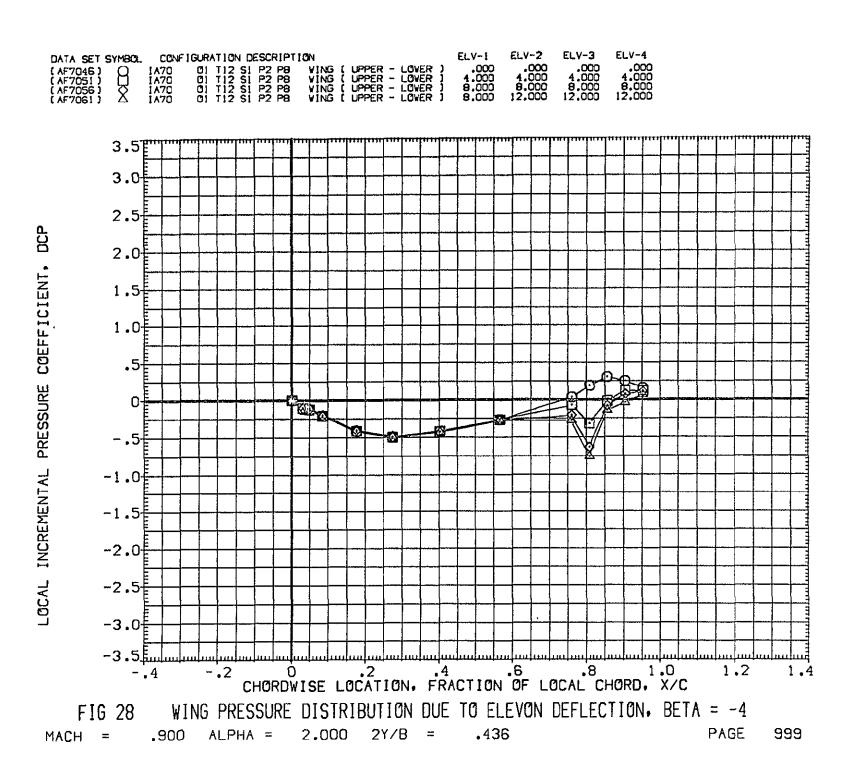


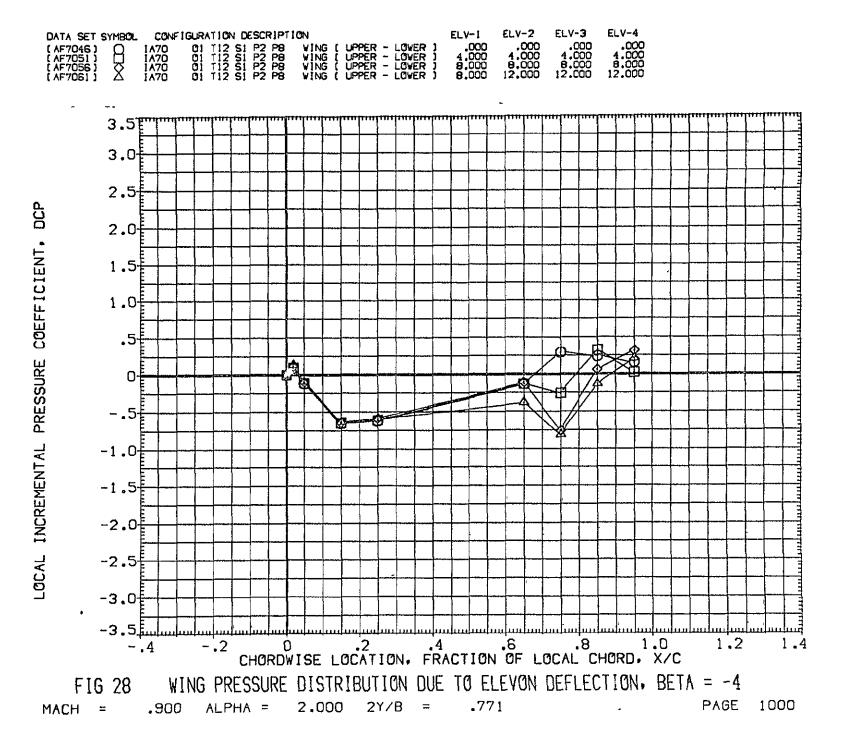


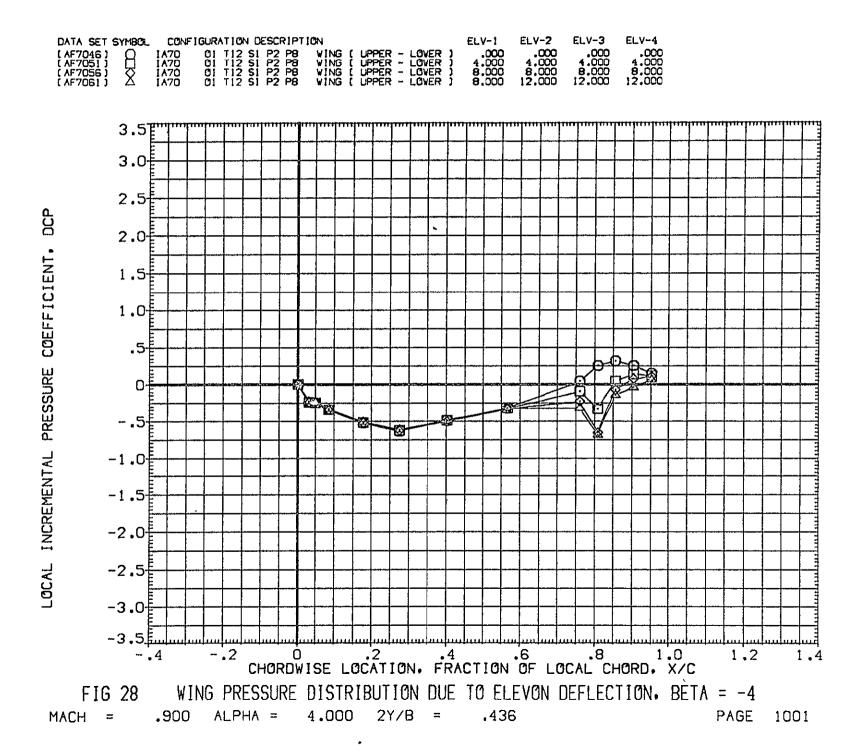


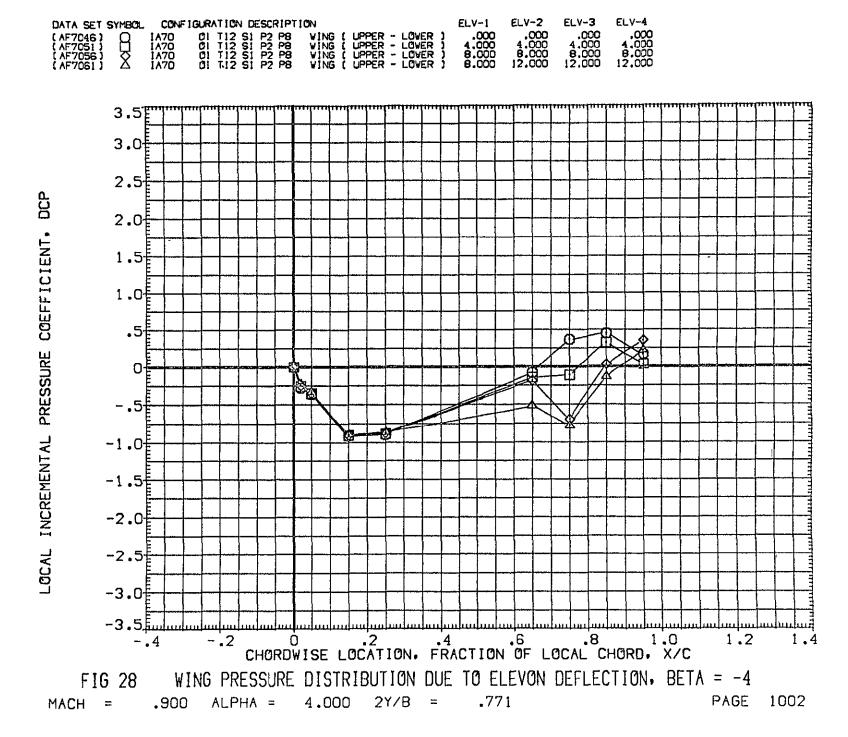


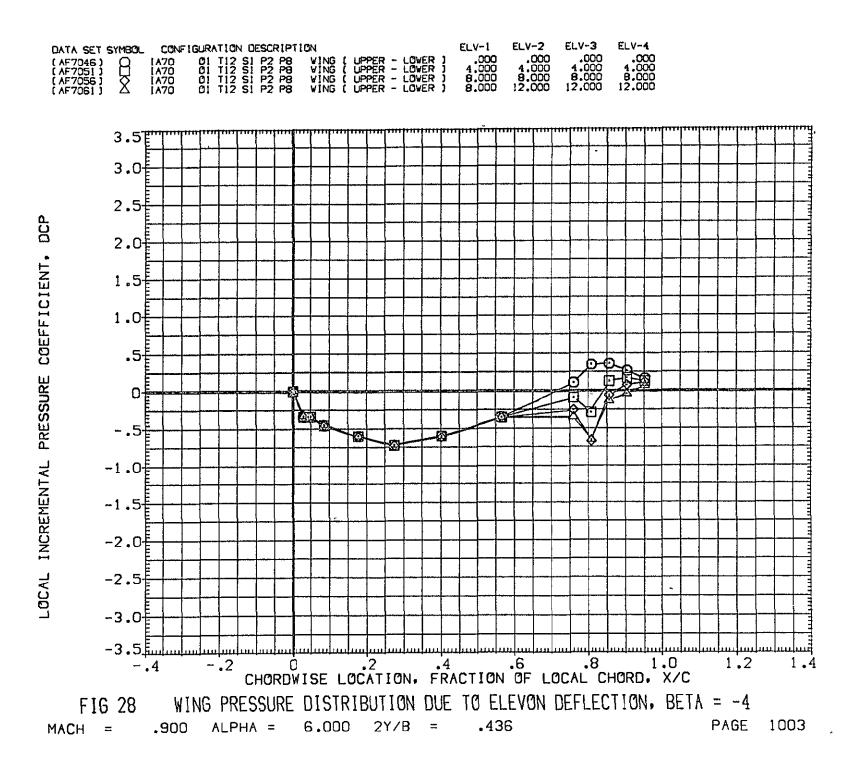


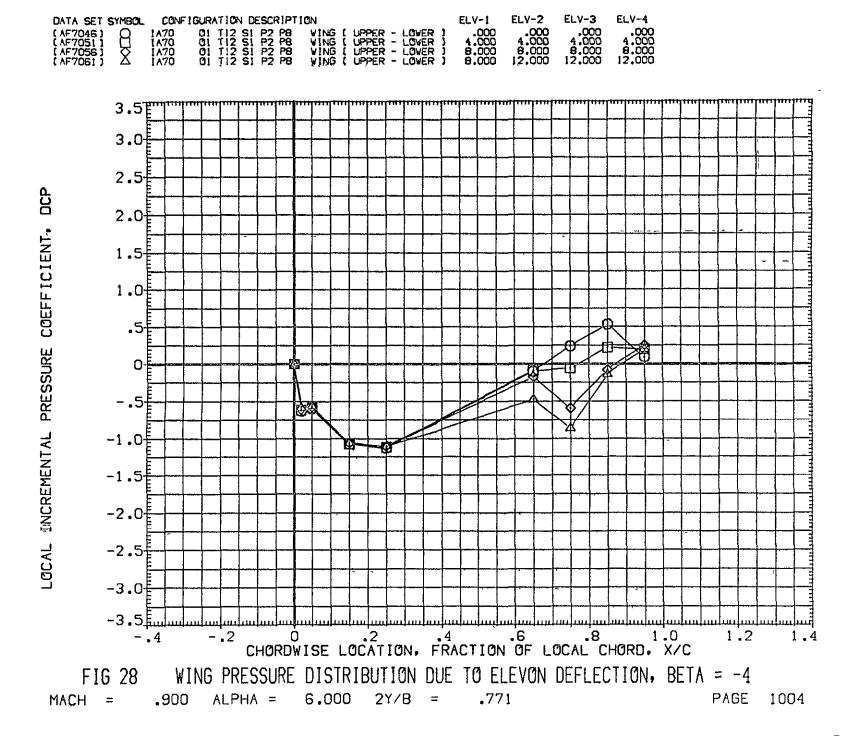


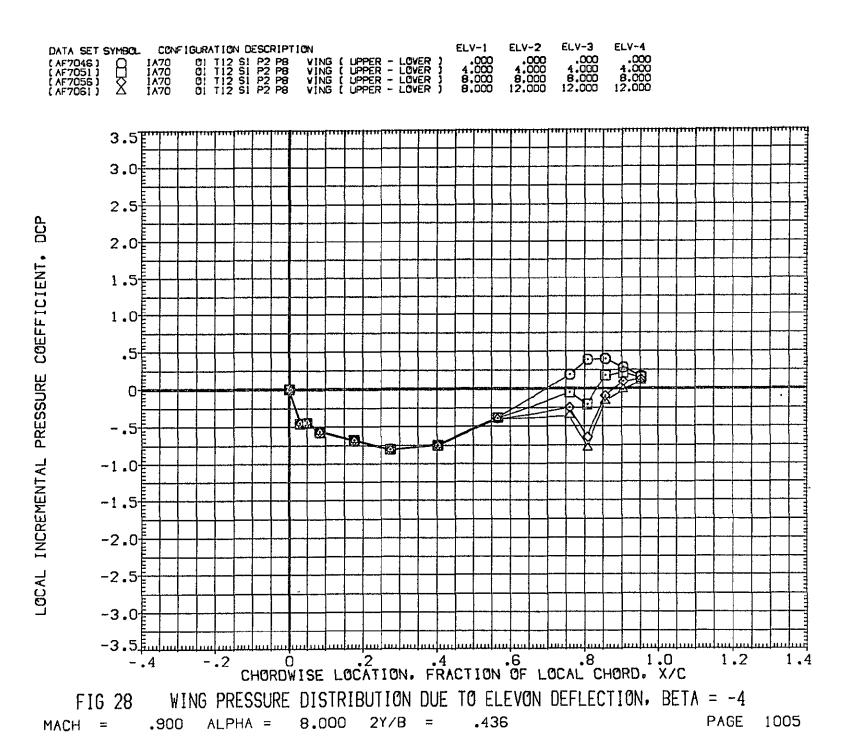


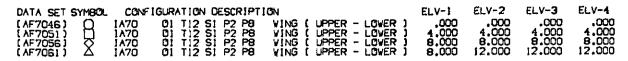


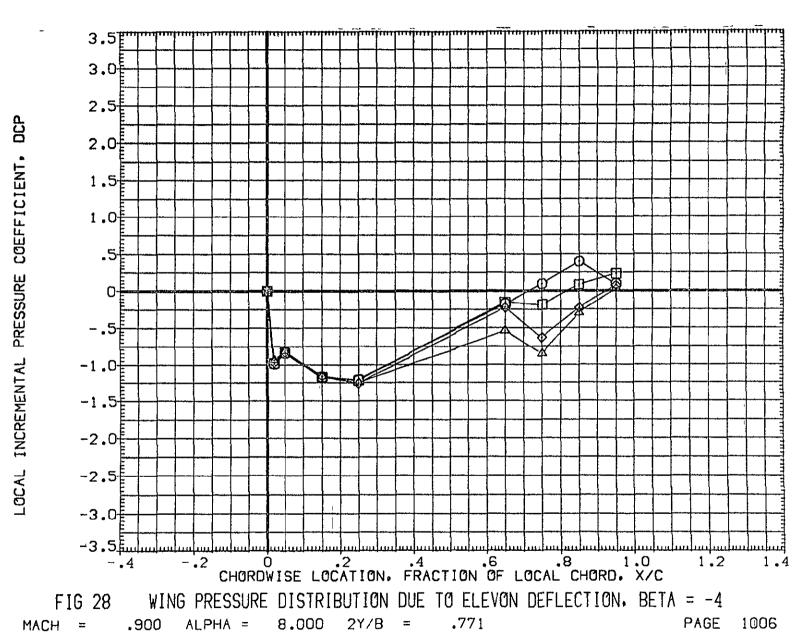


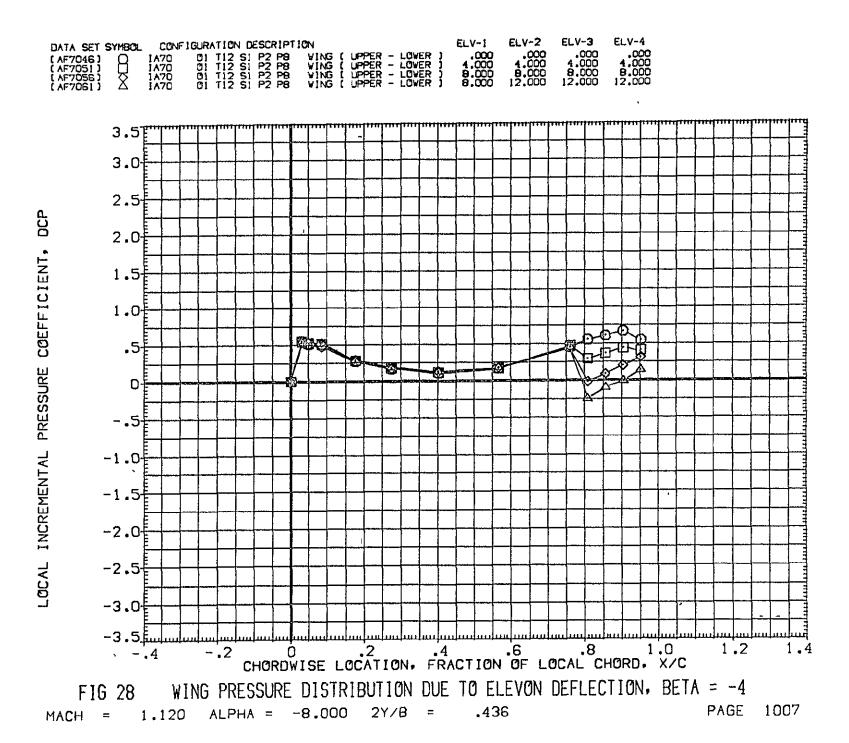


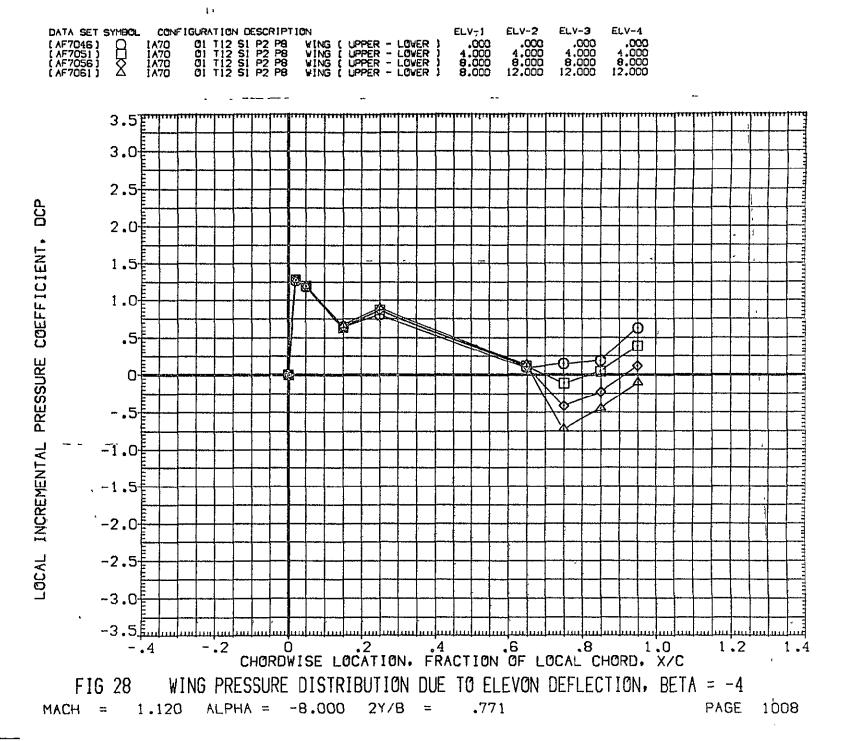


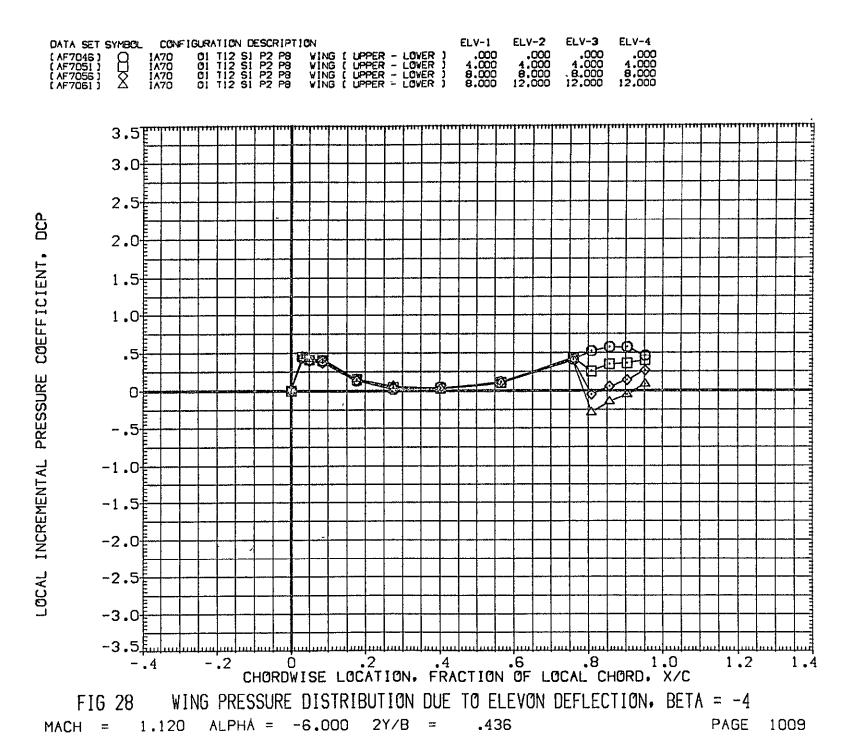


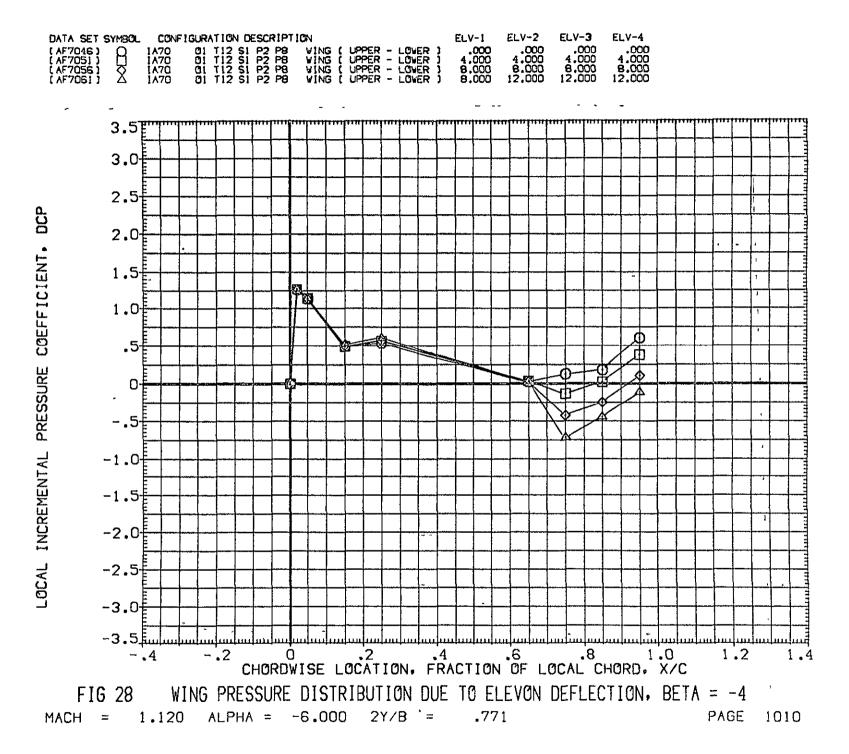


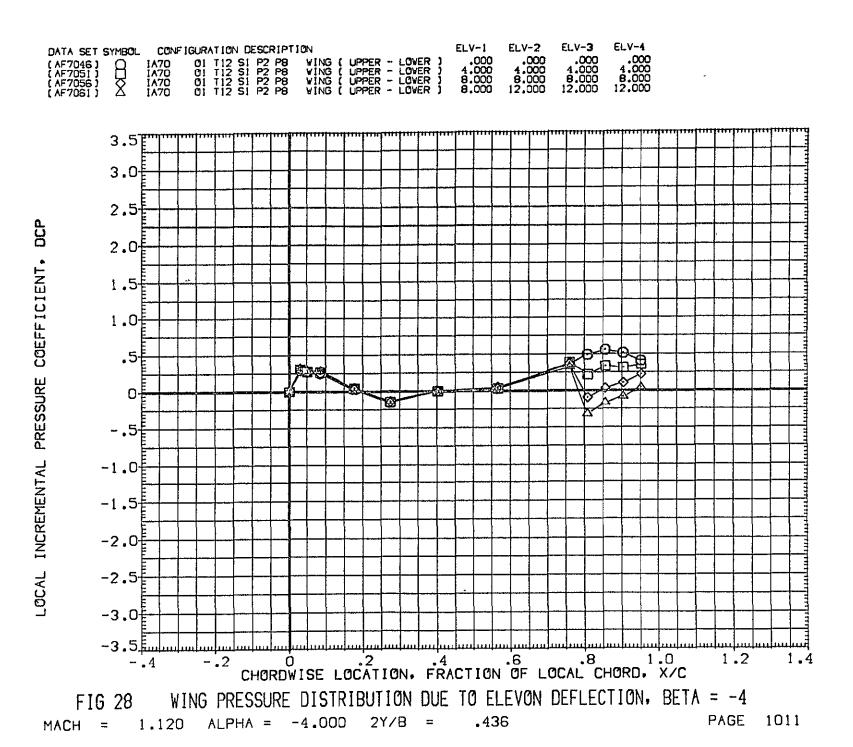


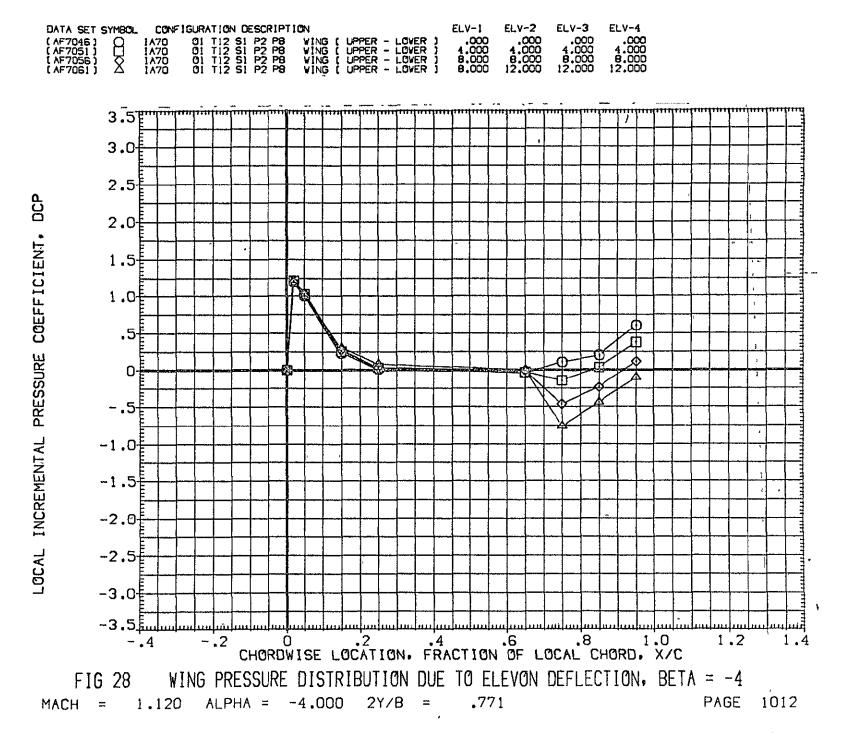


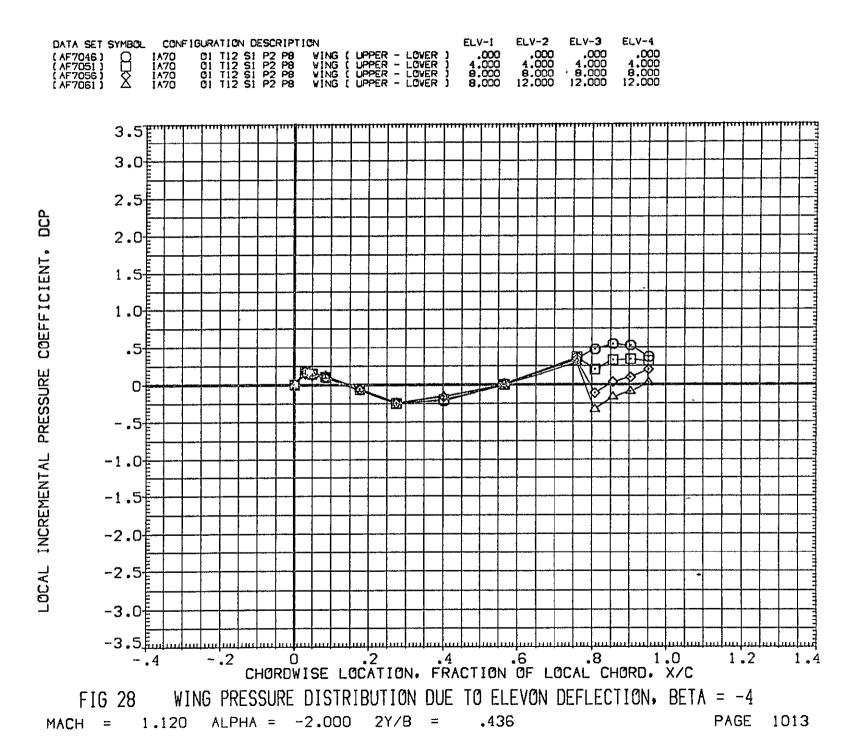


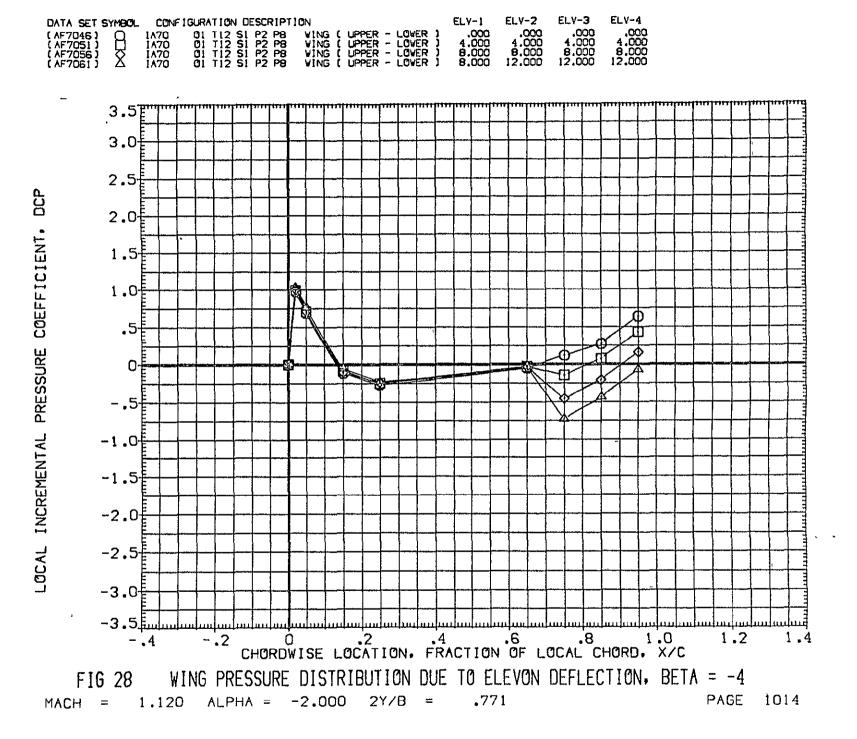


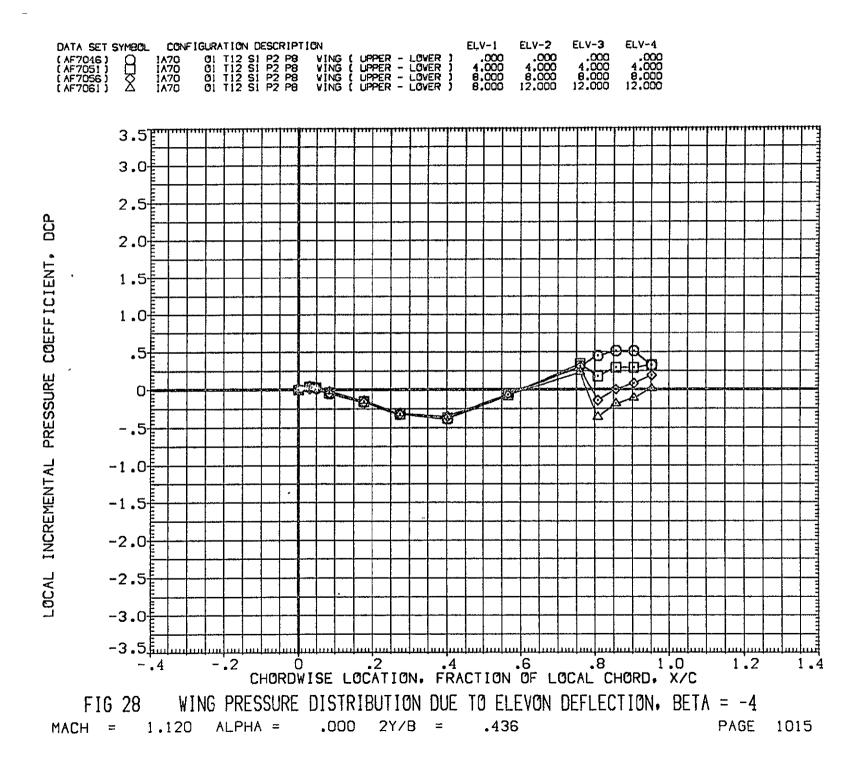


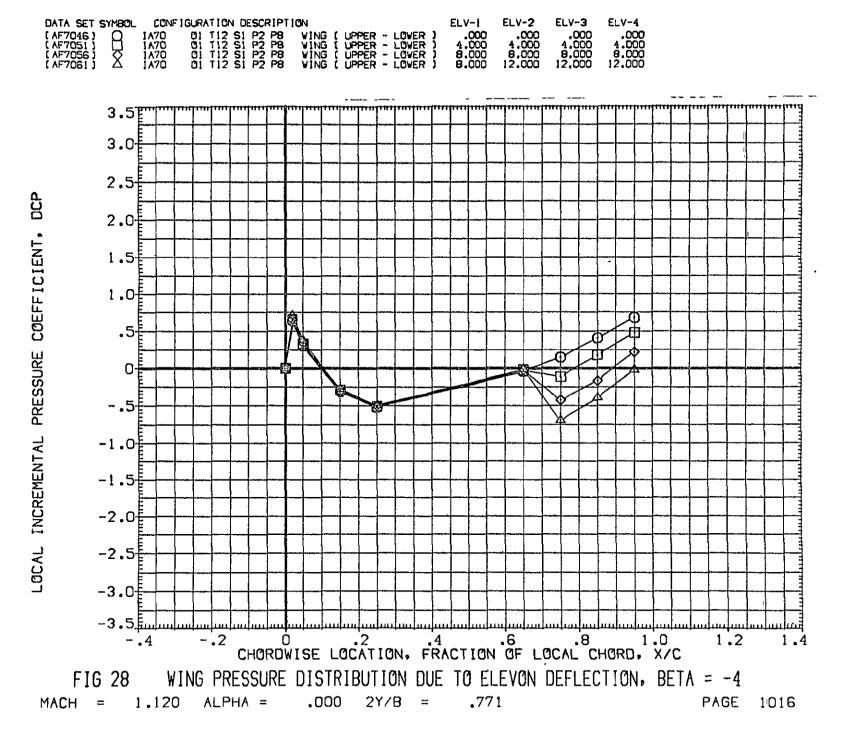


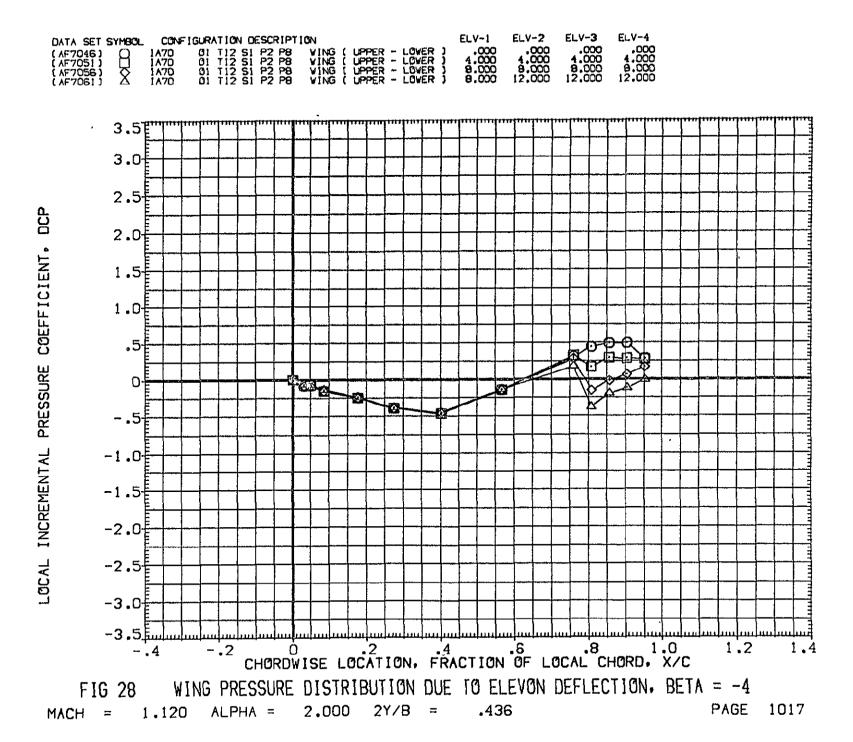


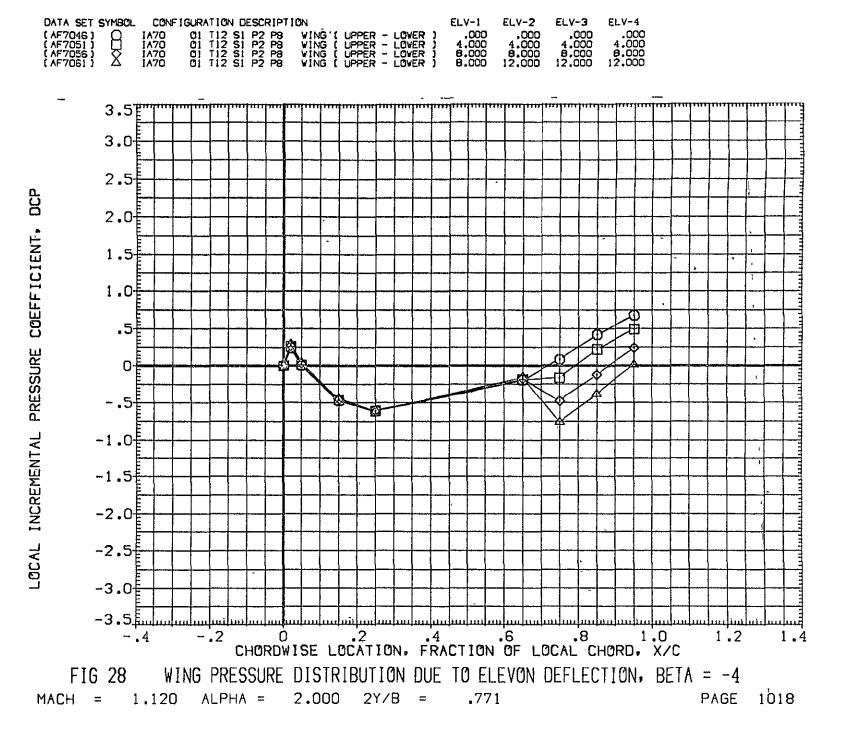


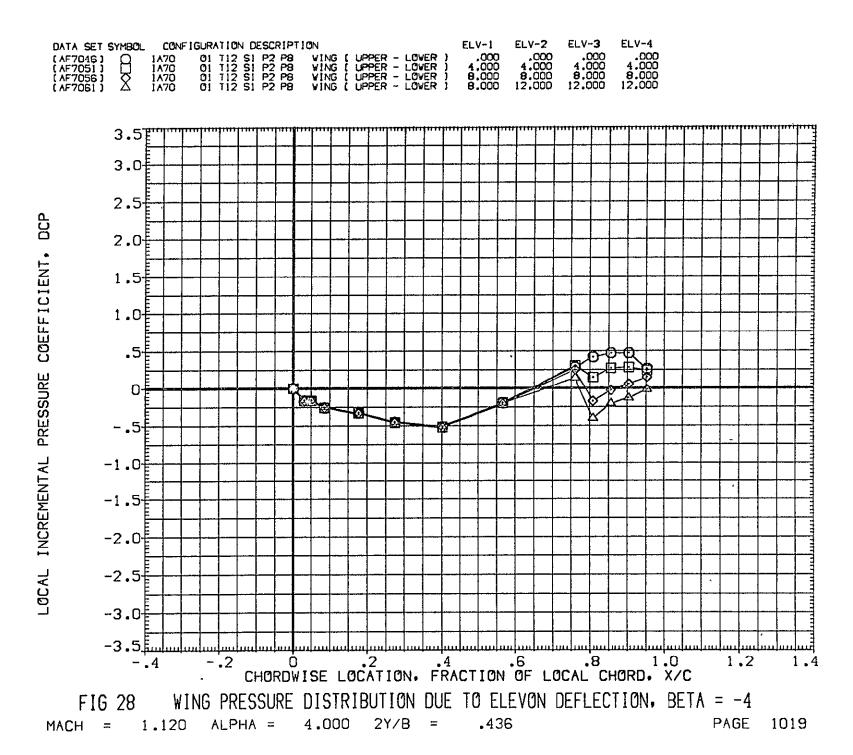


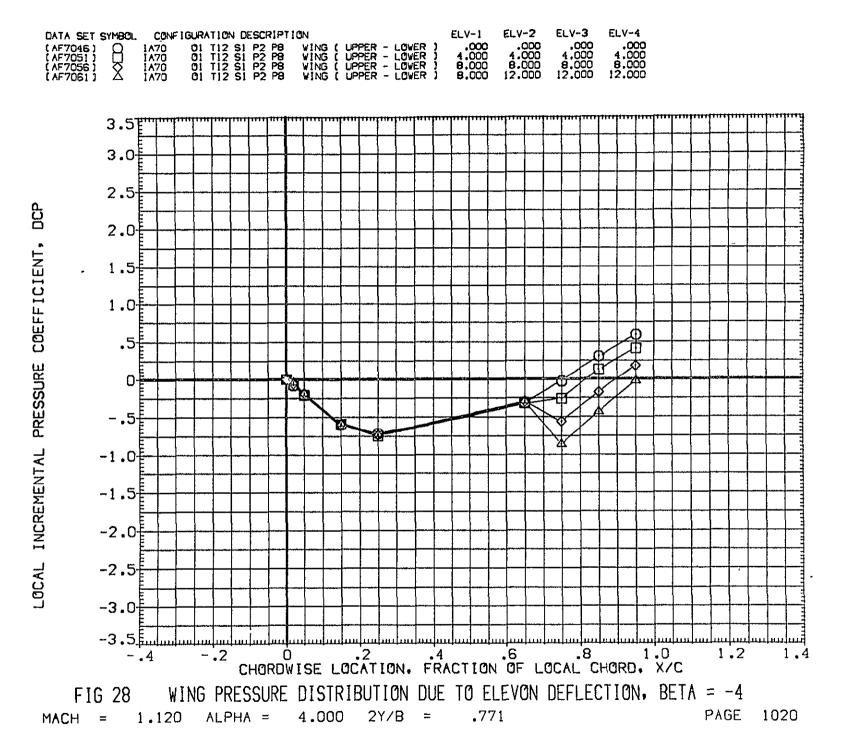


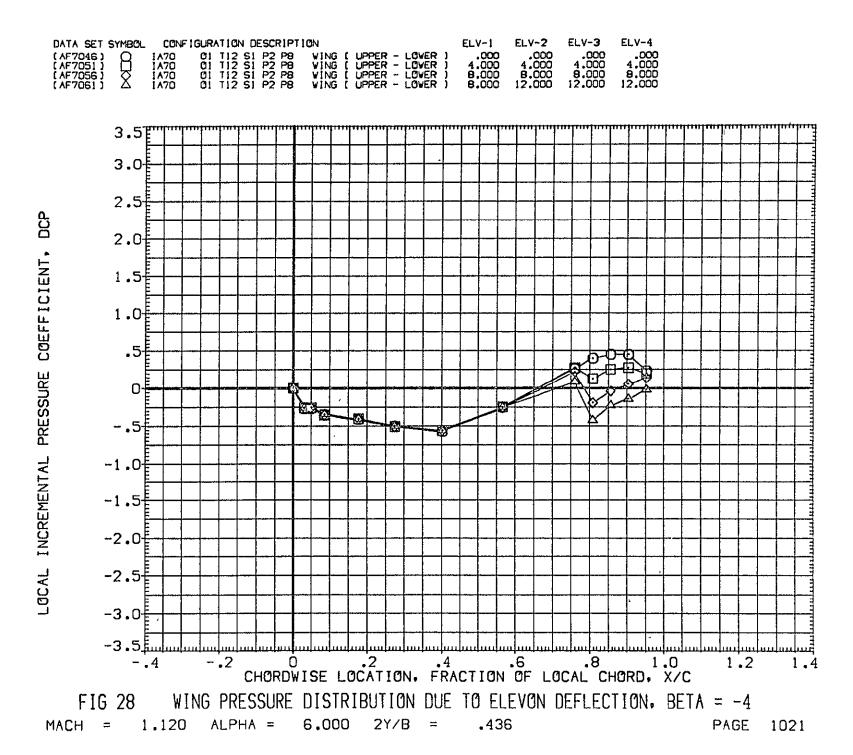


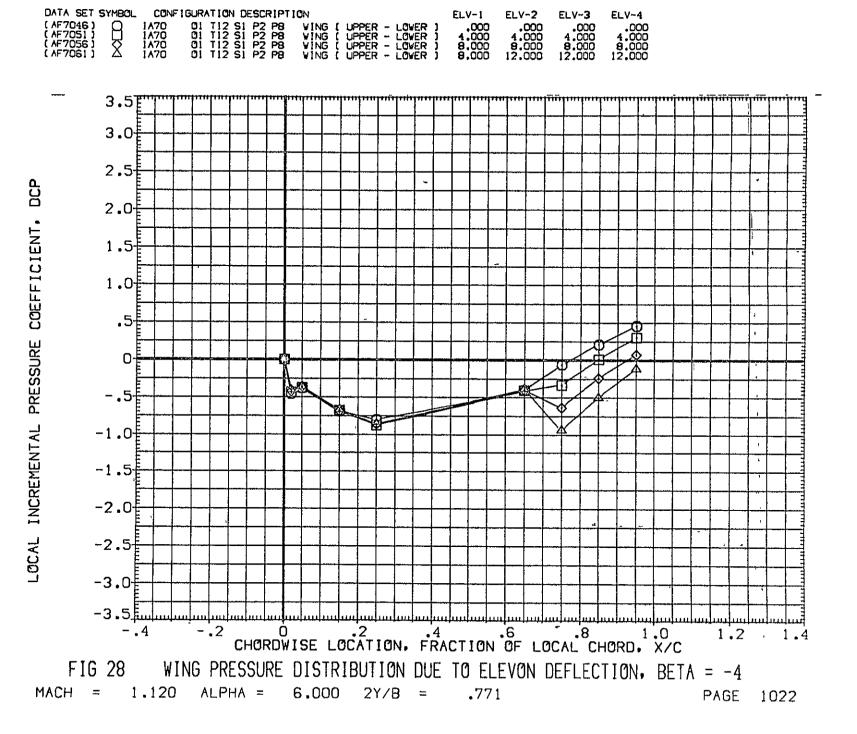


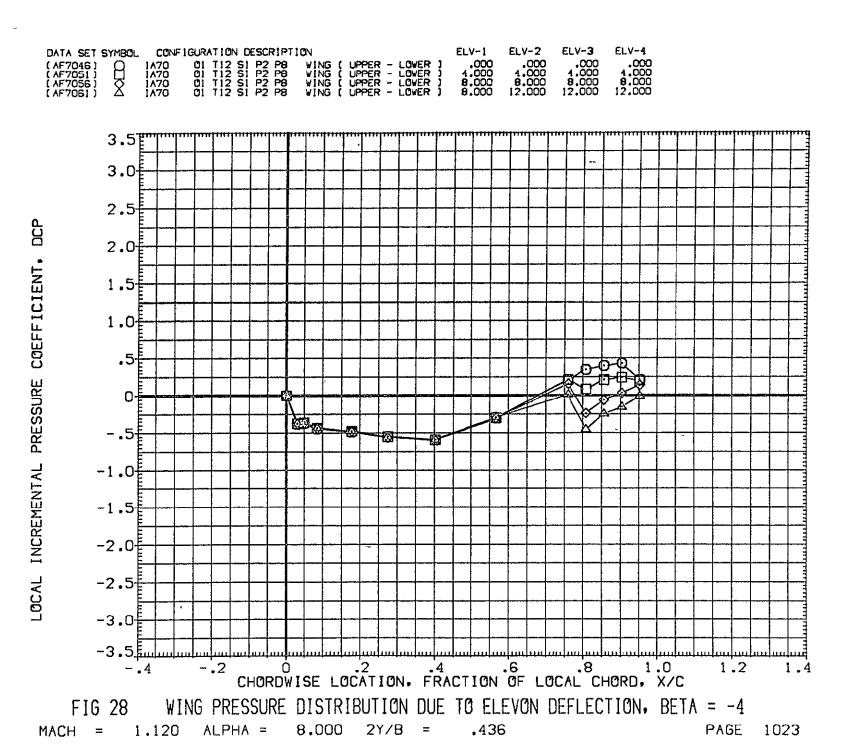




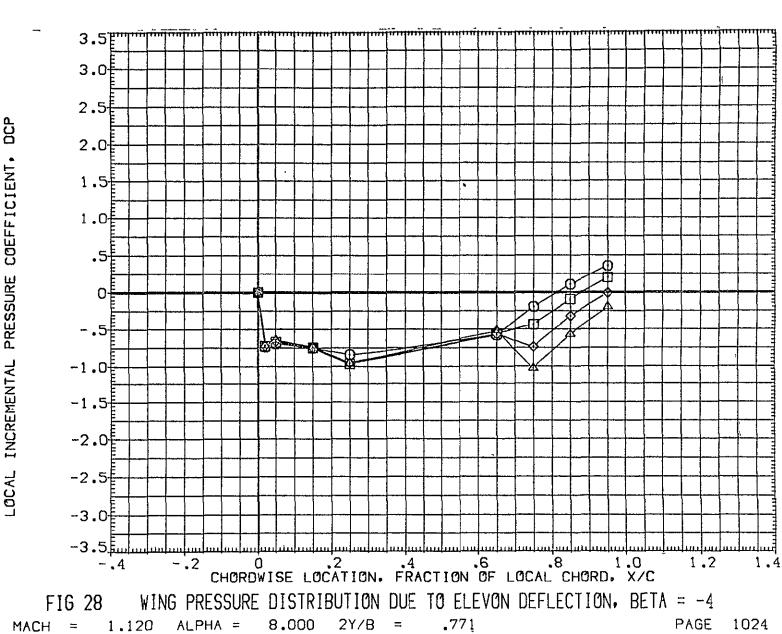


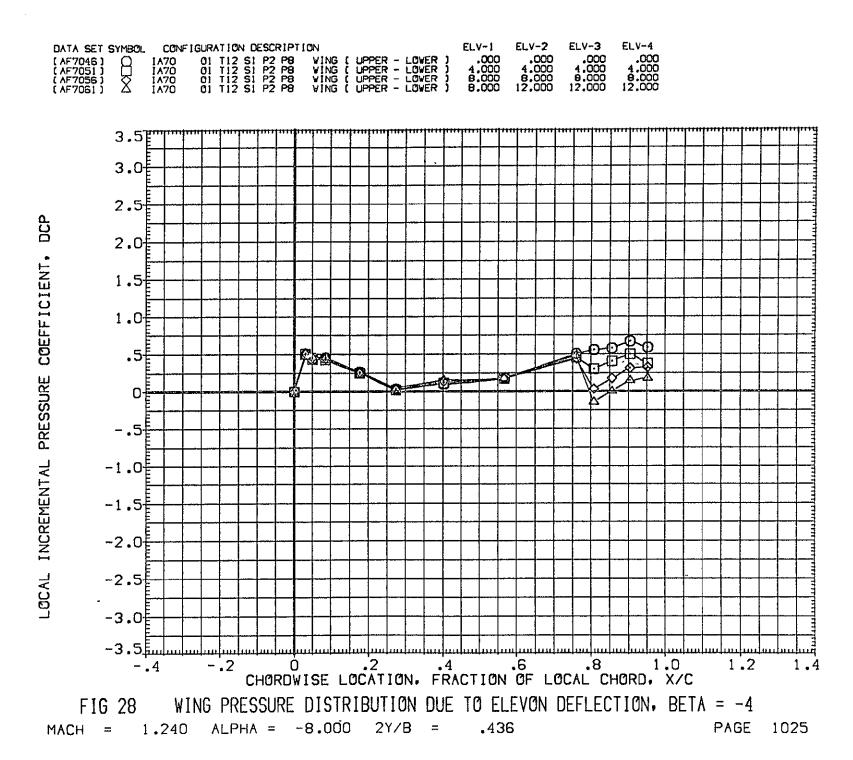


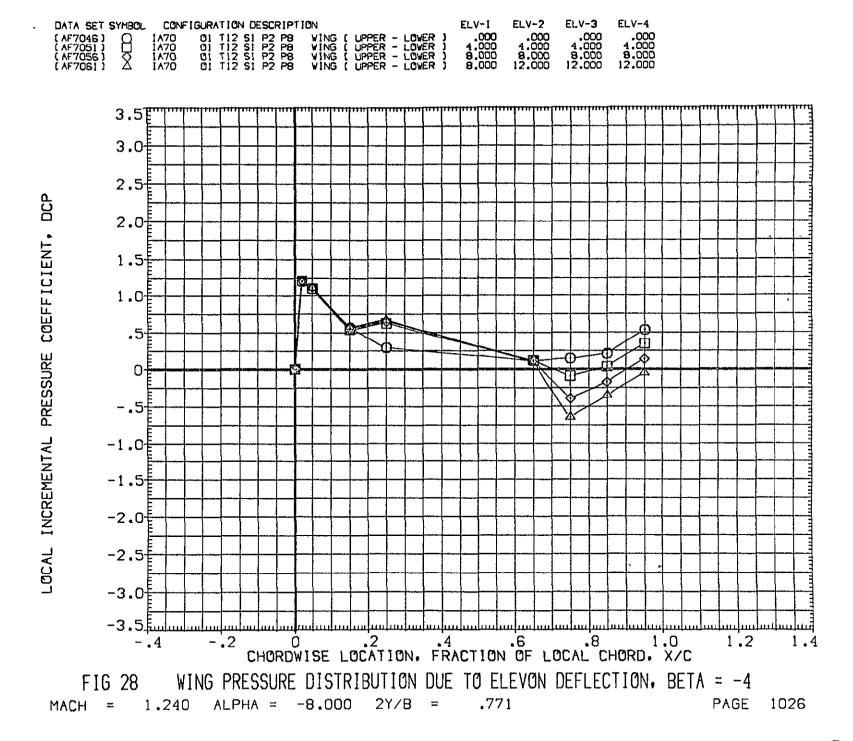


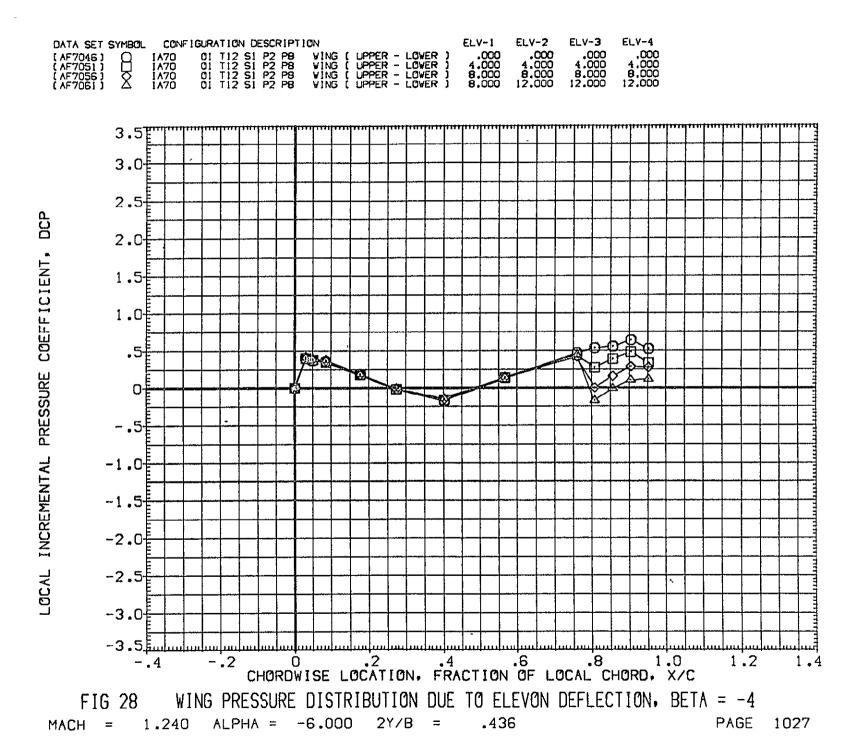












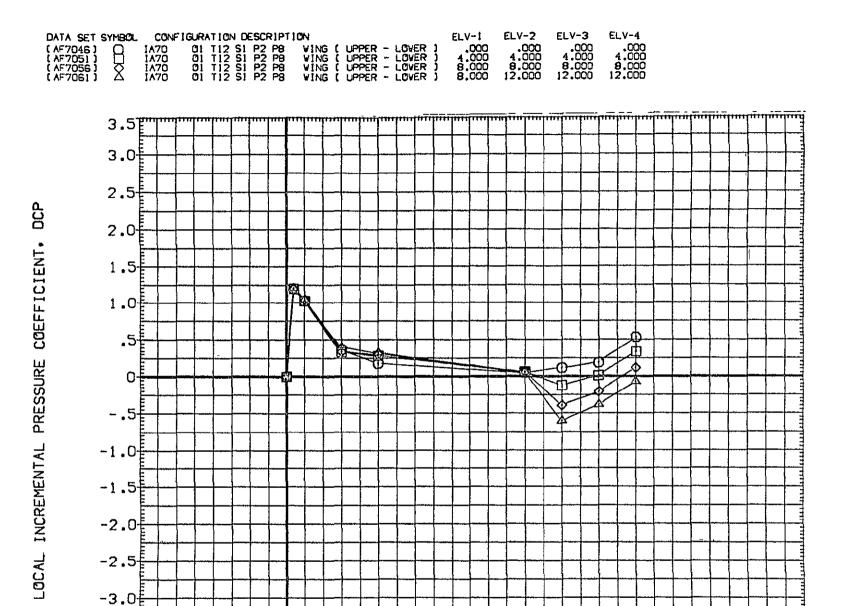


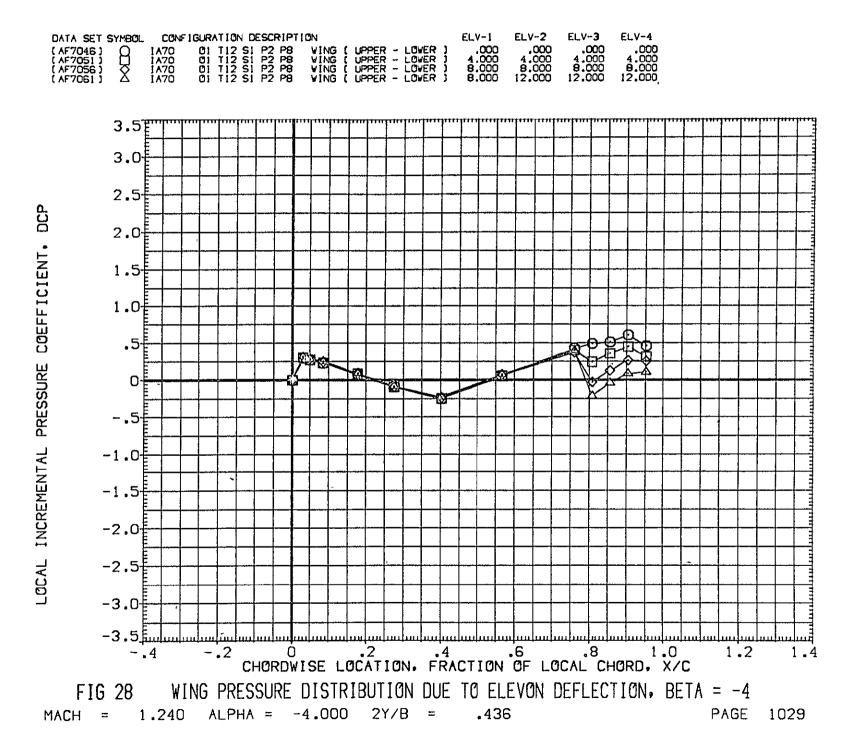
FIG 28 WING PRESSURE DISTRIBUTION DUE TO ELEVON DEFLECTION. BETA = -4

MACH = 1.240 ALPHA = -6.000 2Y/B = .771 PAGE 1028

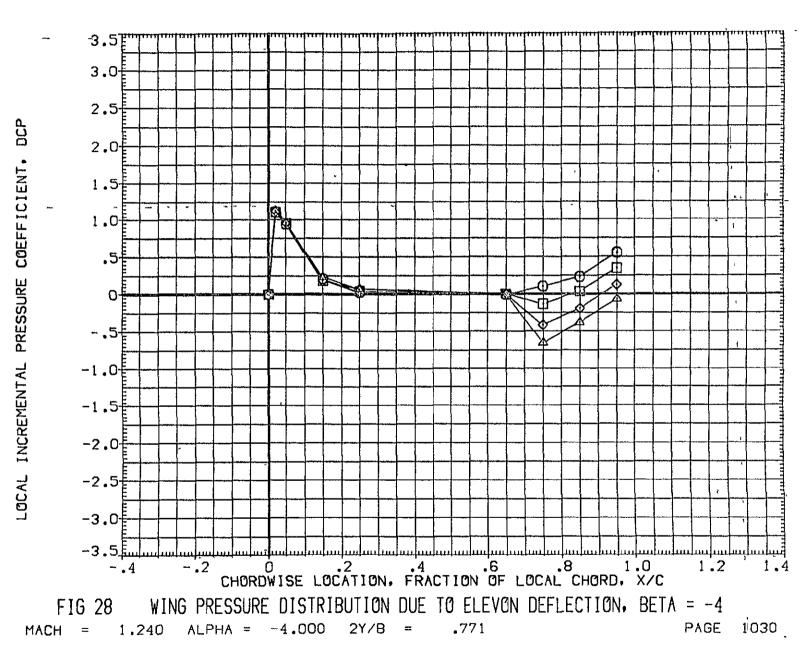
O .2 .4 .6 .8 1.0 CHORDWISE LOCATION, FRACTION OF LOCAL CHORD, X/C

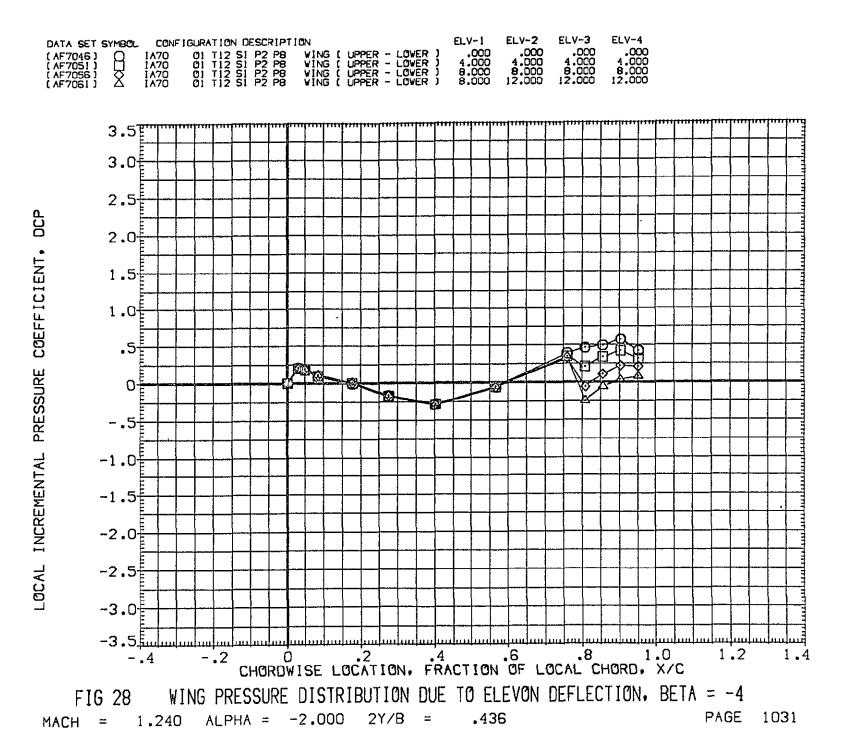
1.2

-3.5<u>E</u>









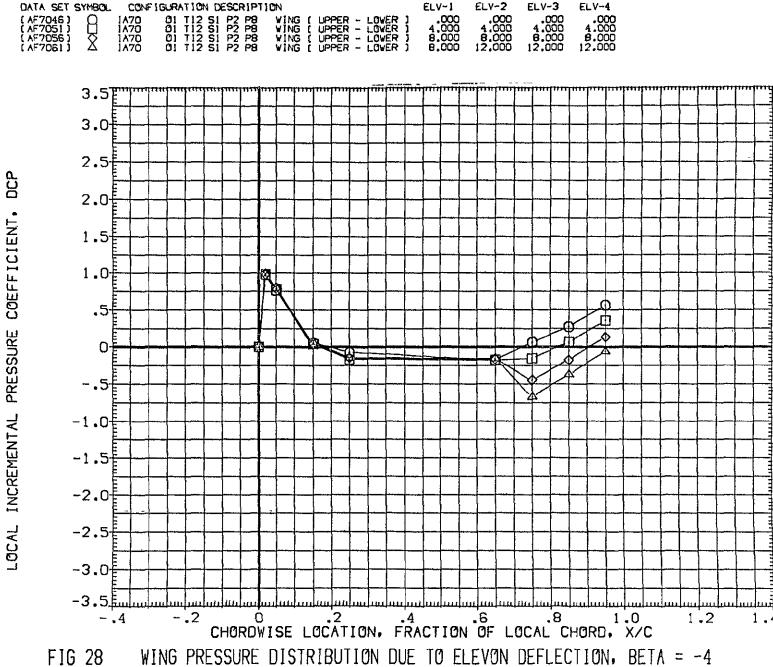
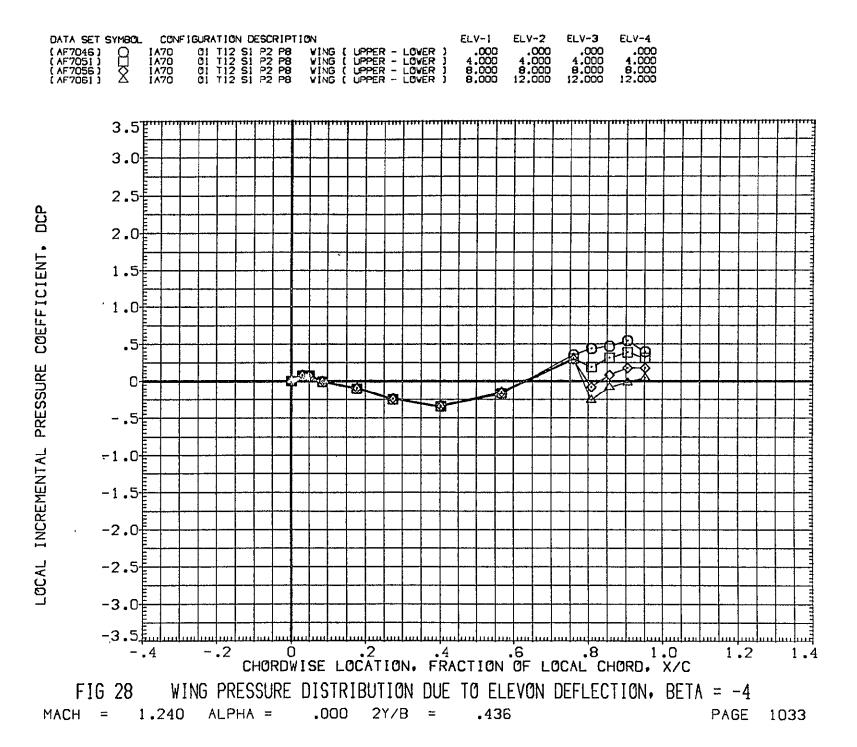
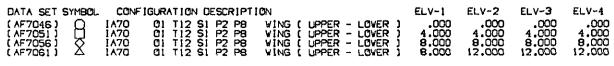
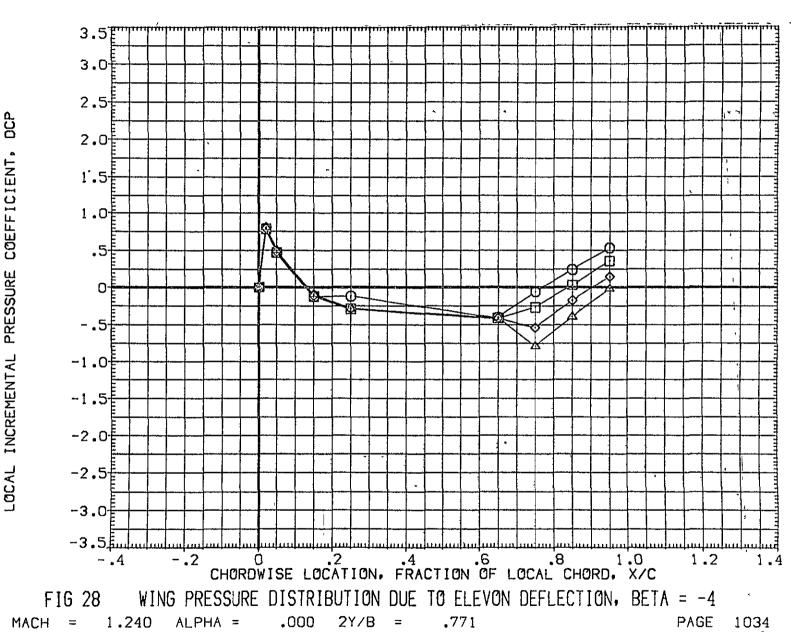


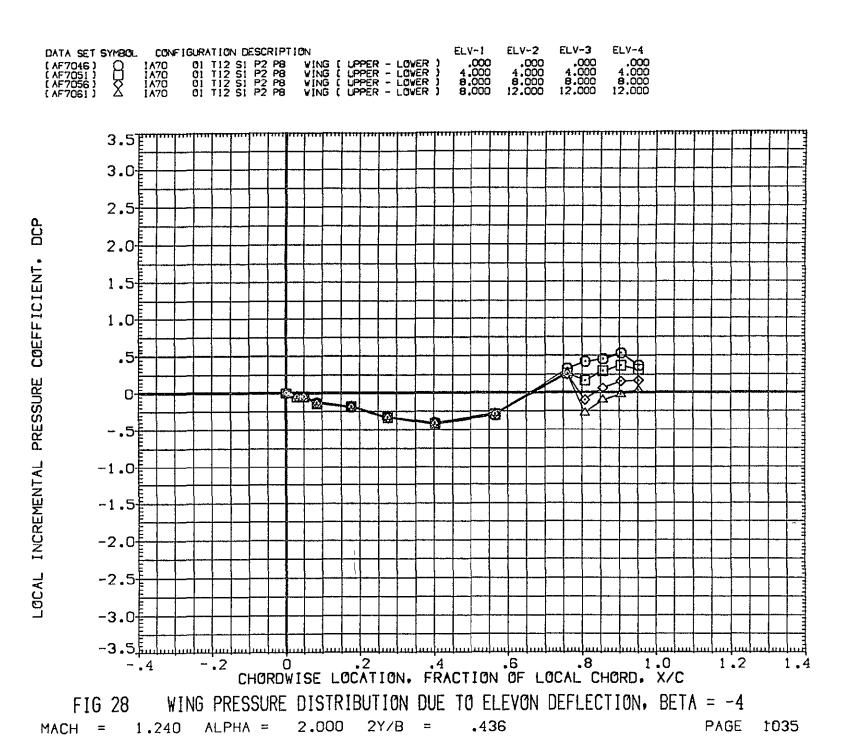
FIG 28 WING PRESSURE DISTRIBUTION DUE TO ELEVON DEFLECTION, BETA = -4

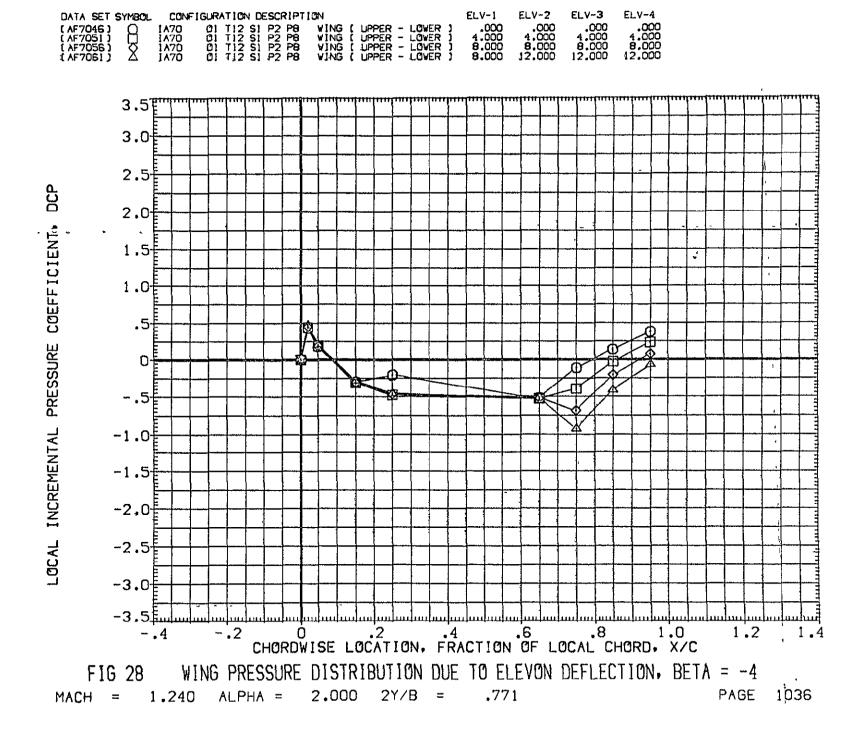
MACH = 1.240 ALPHA = -2.000 2Y/B = .771 PAGE 1032

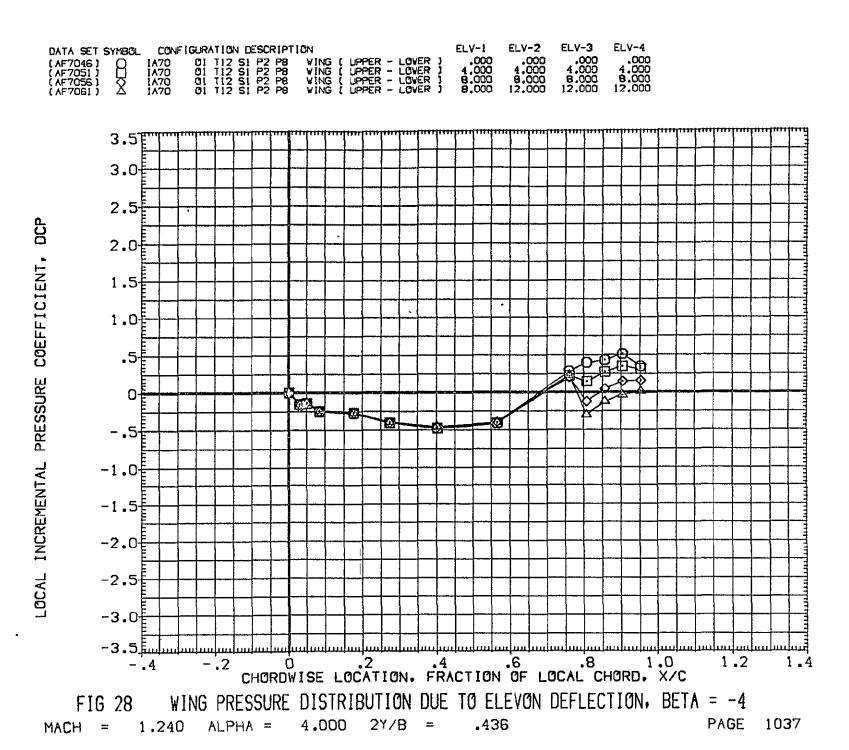


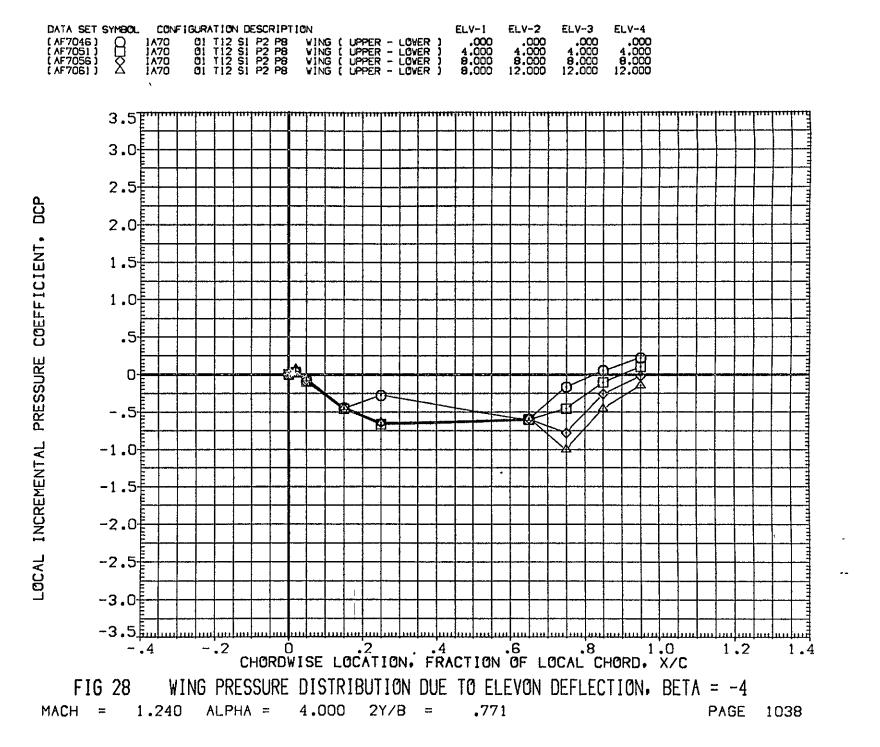


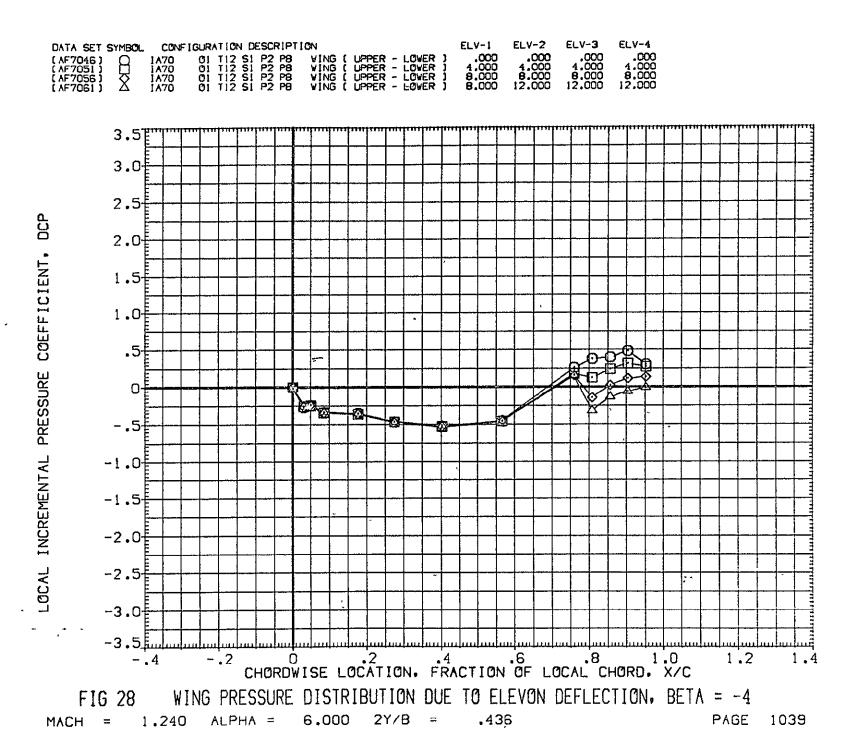


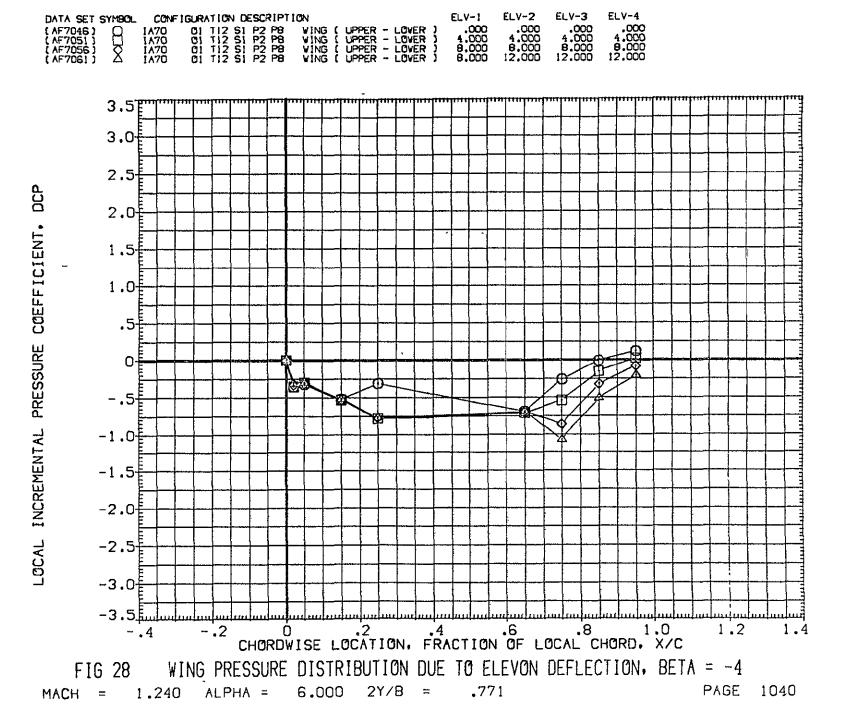


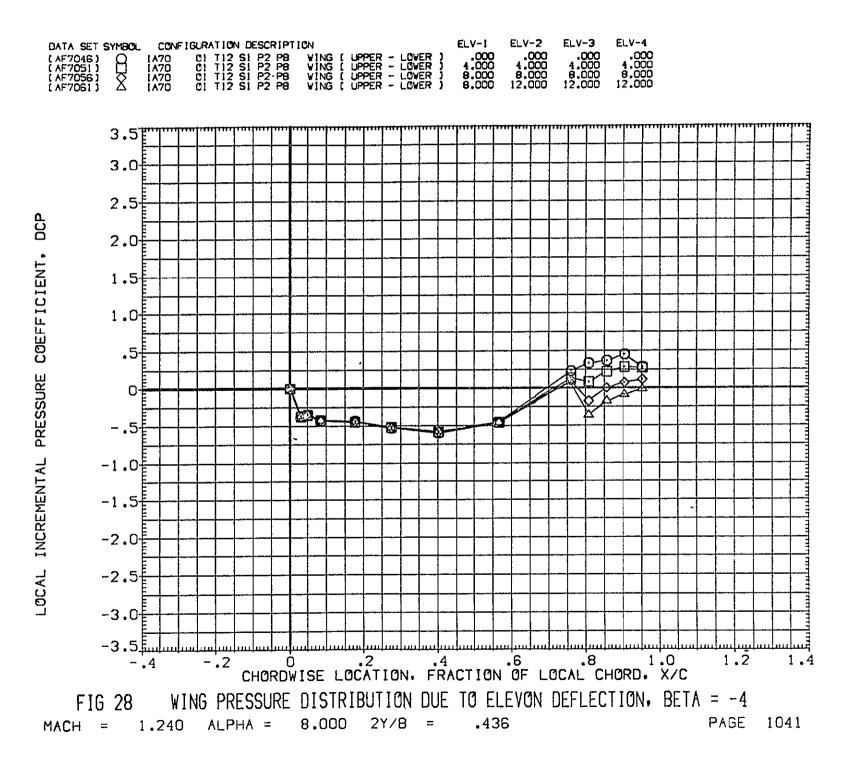




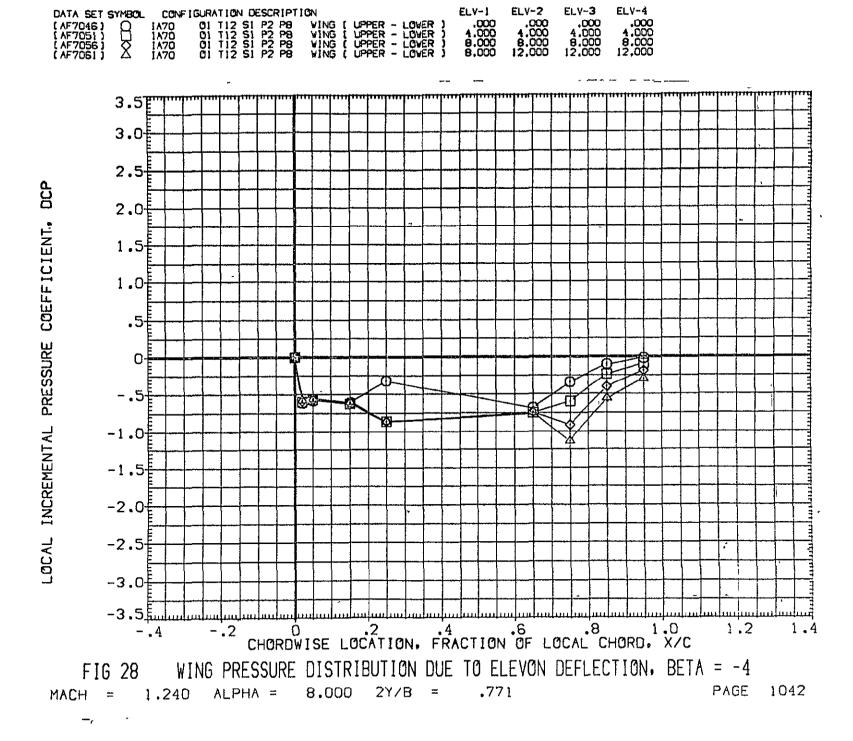


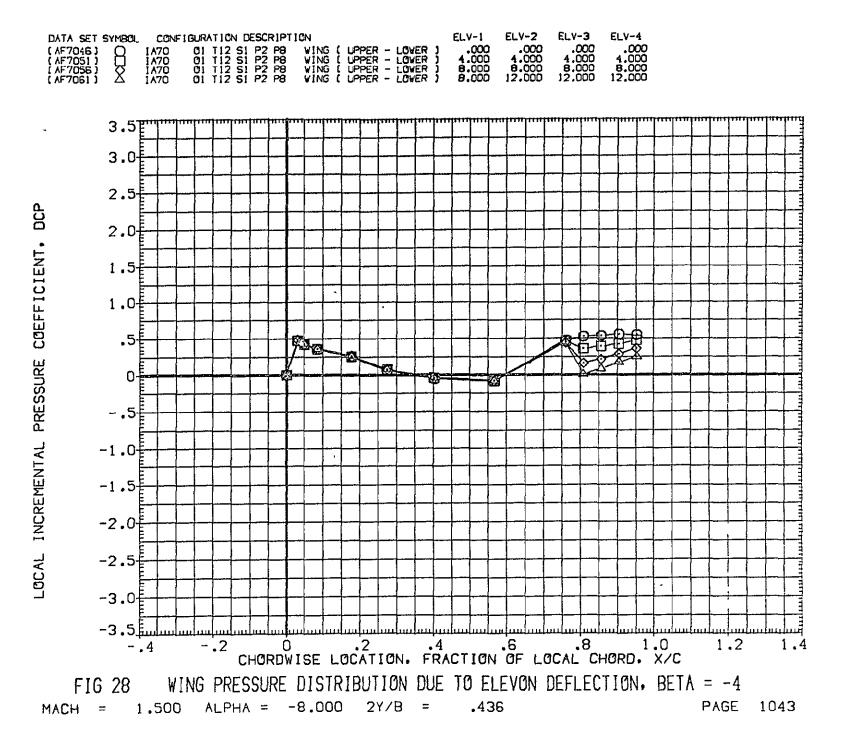


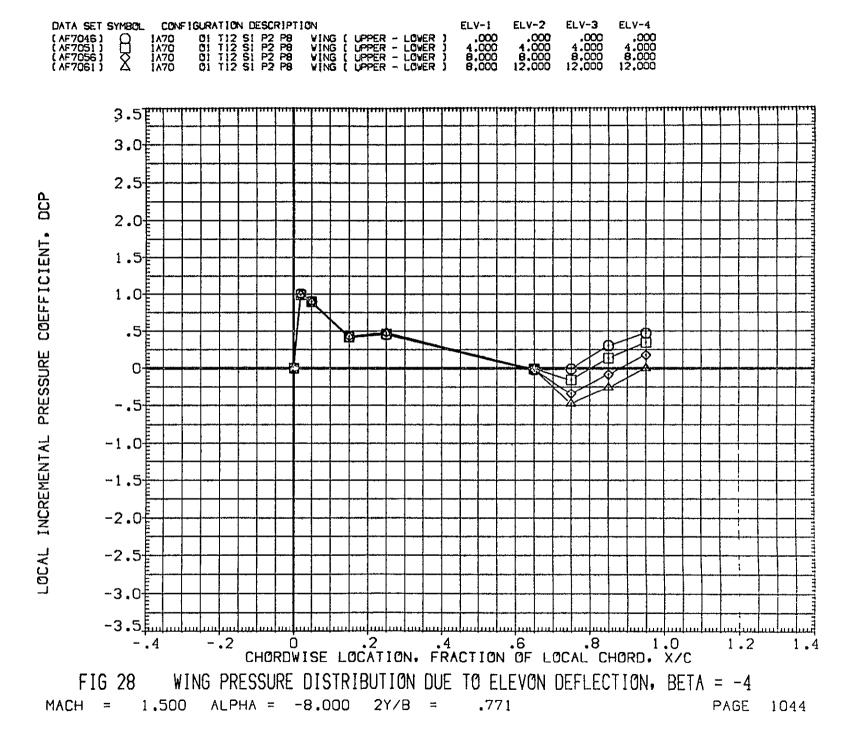


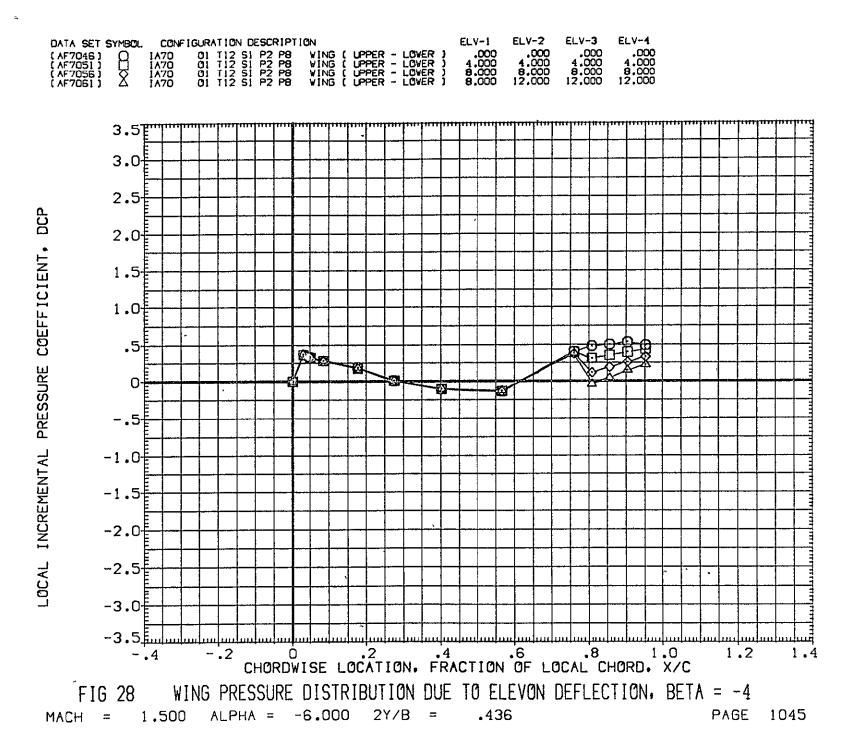


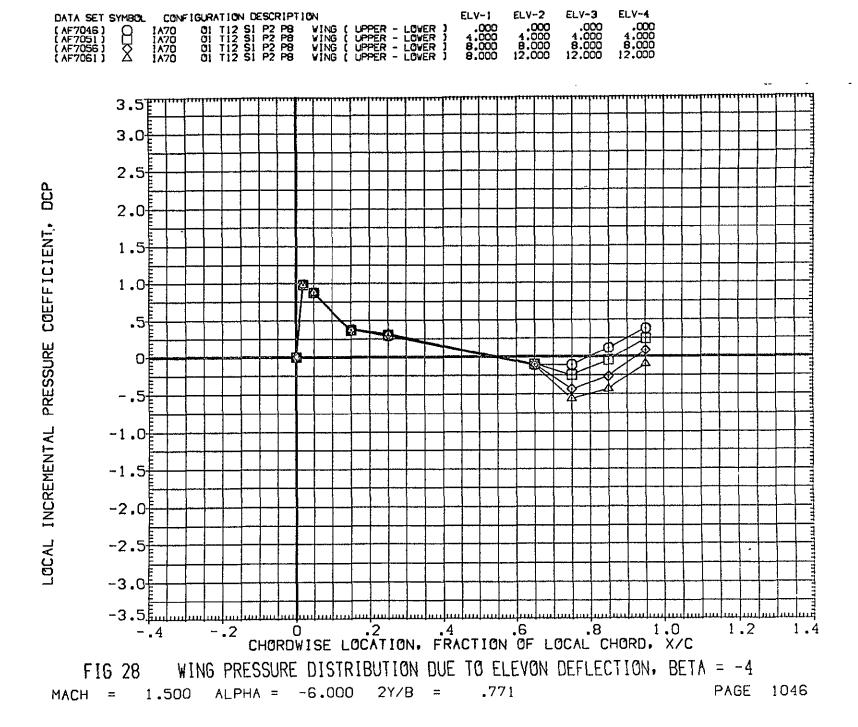


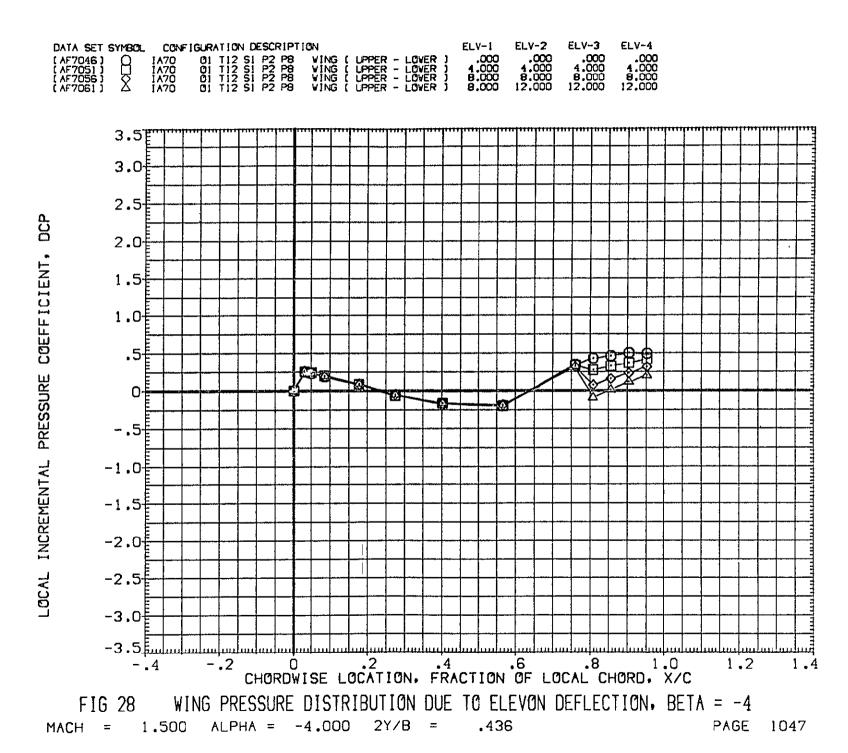


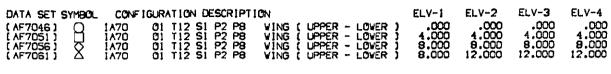












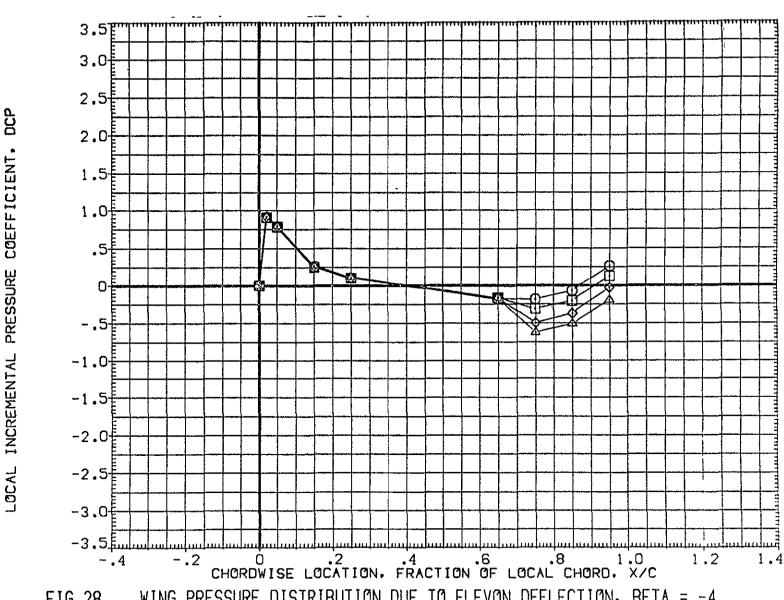
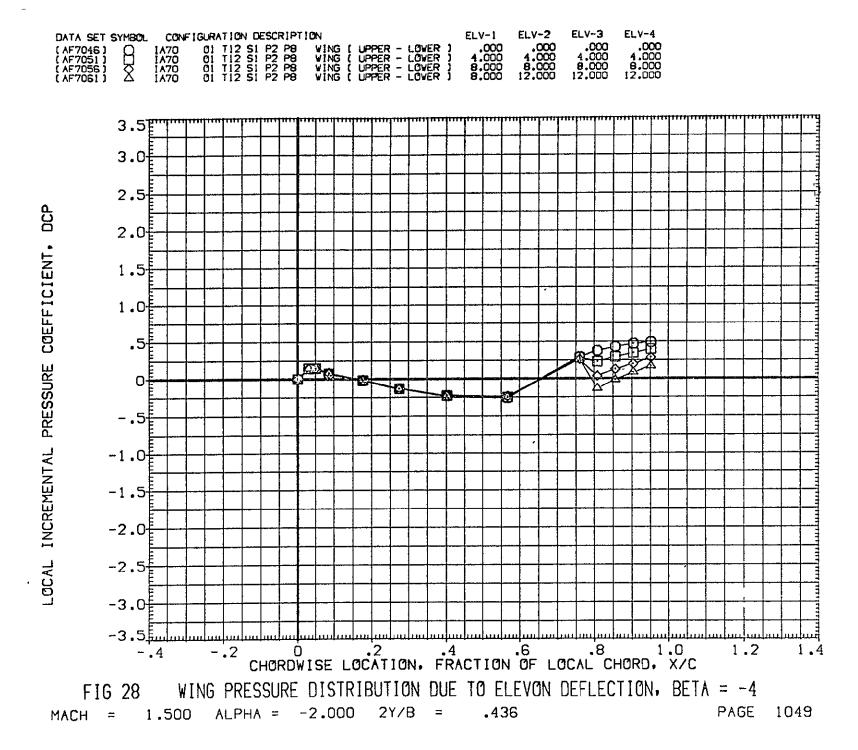
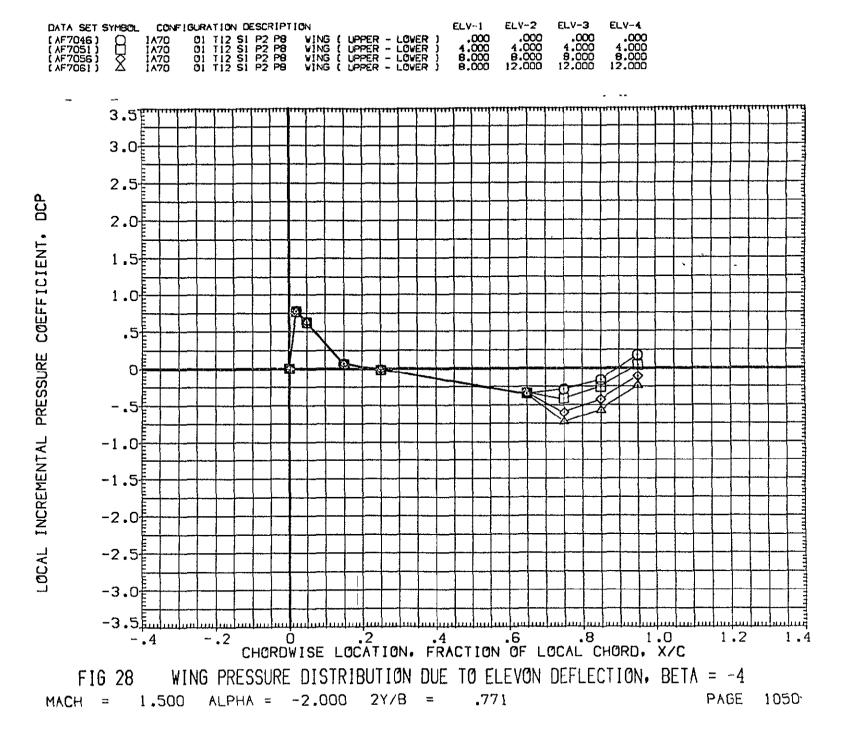
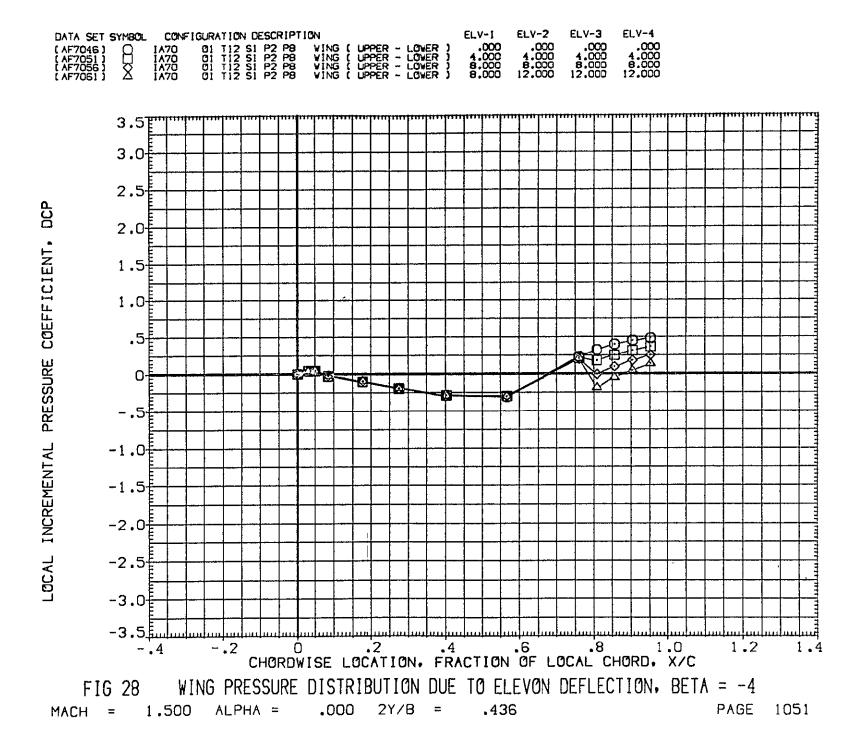


FIG 28 WING PRESSURE DISTRIBUTION DUE TO ELEVON DEFLECTION, BETA = -4

MACH = 1.500 ALPHA = -4.000 2Y/B = .771 PAGE 1048







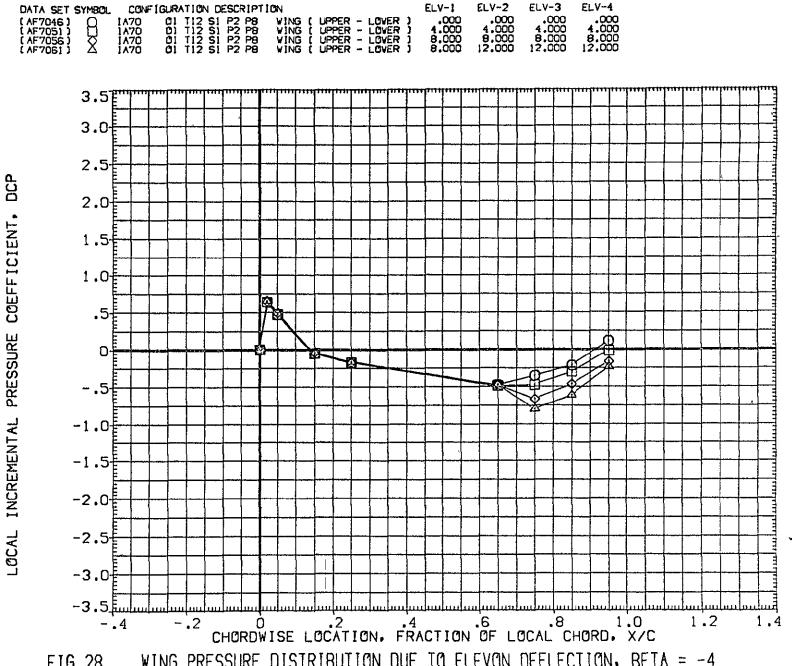
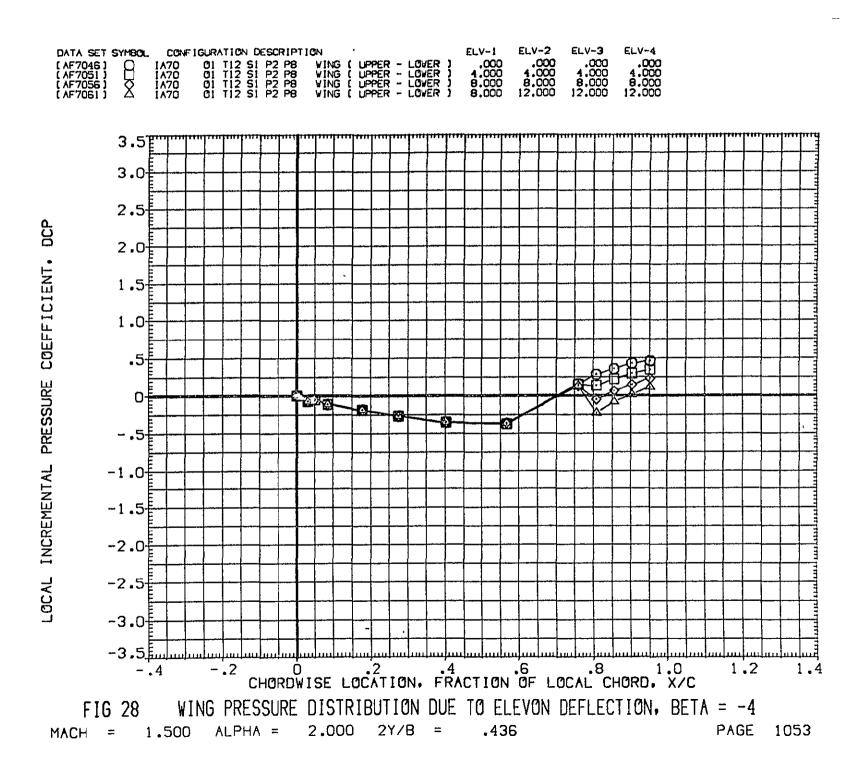
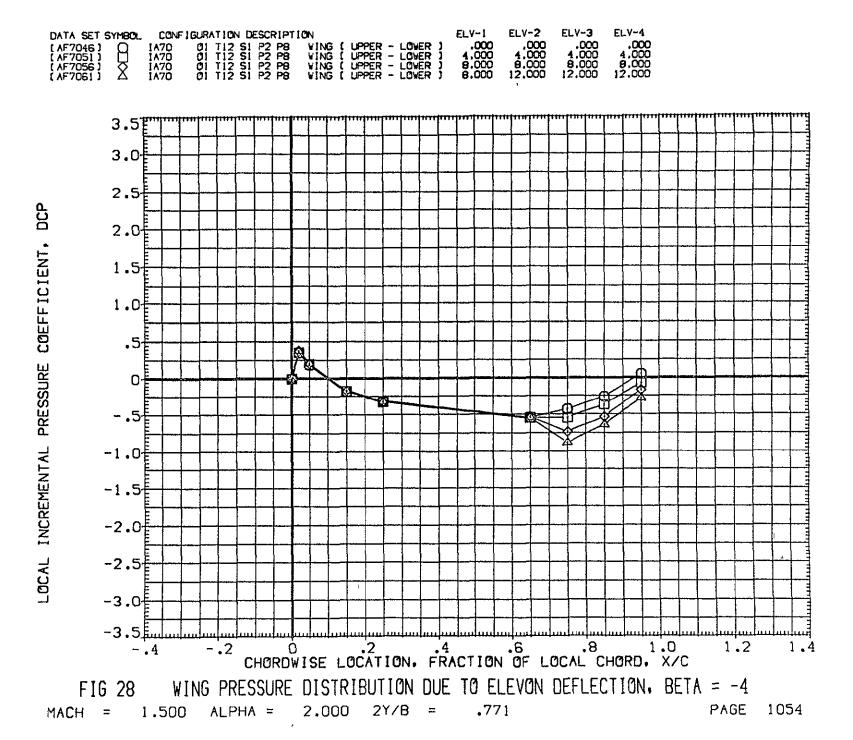
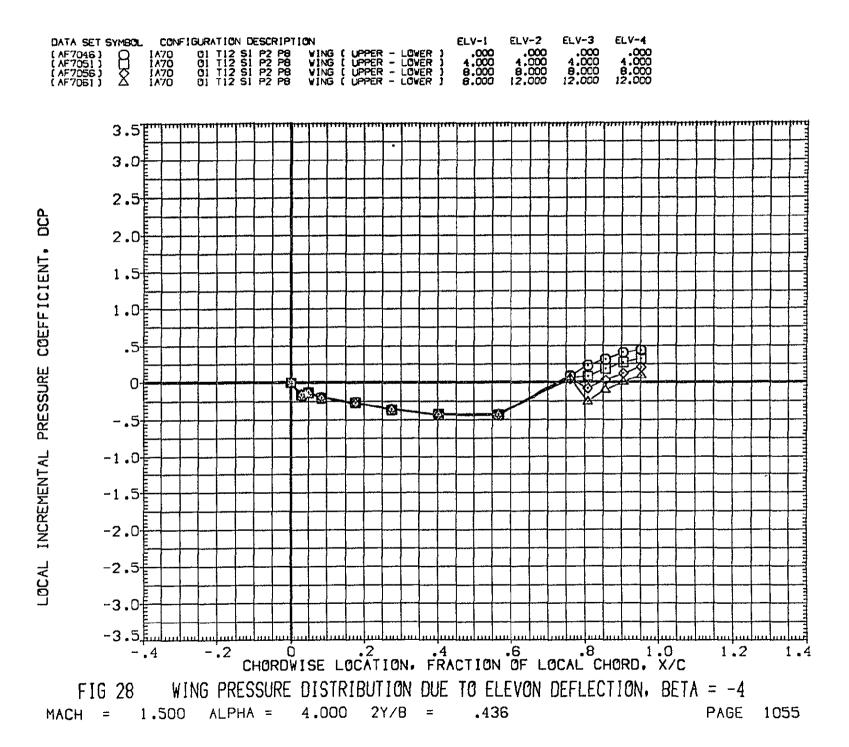


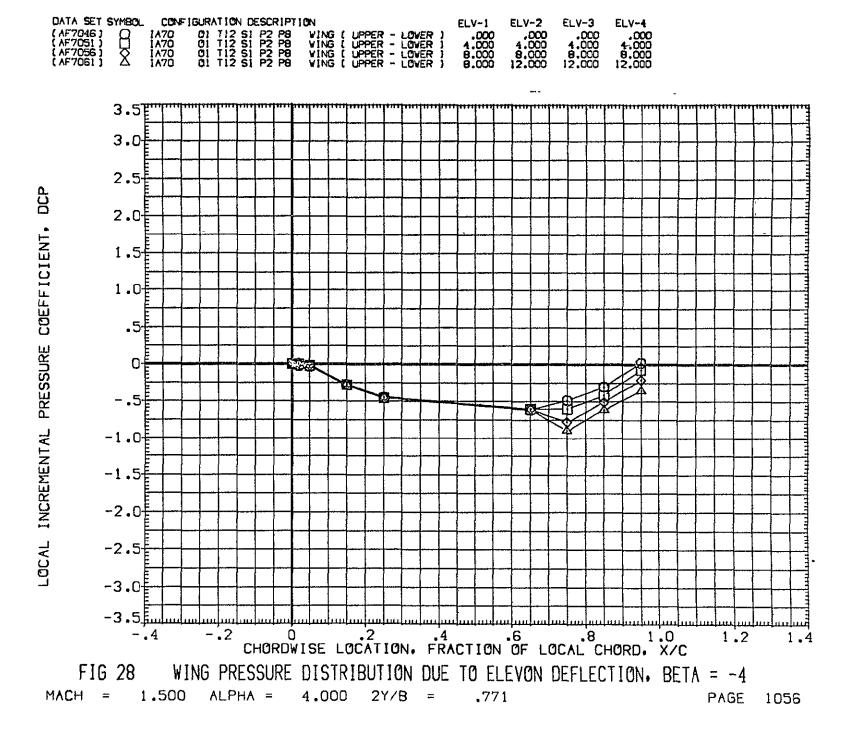
FIG 28 WING PRESSURE DISTRIBUTION DUE TO ELEVON DEFLECTION, BETA = -4

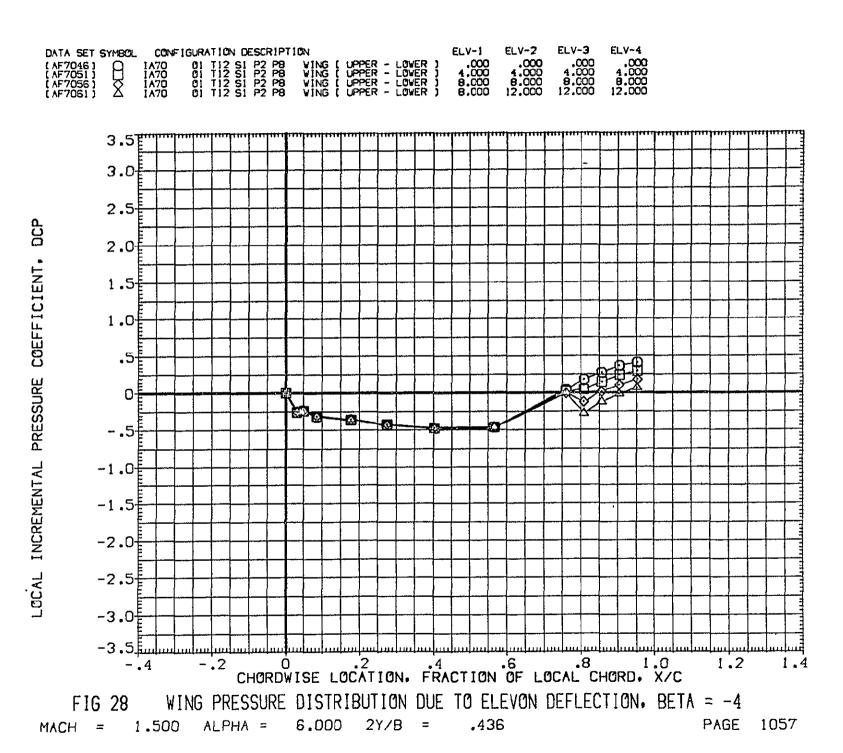
MACH = 1.500 ALPHA = .000 2Y/B = .771 PAGE 1052

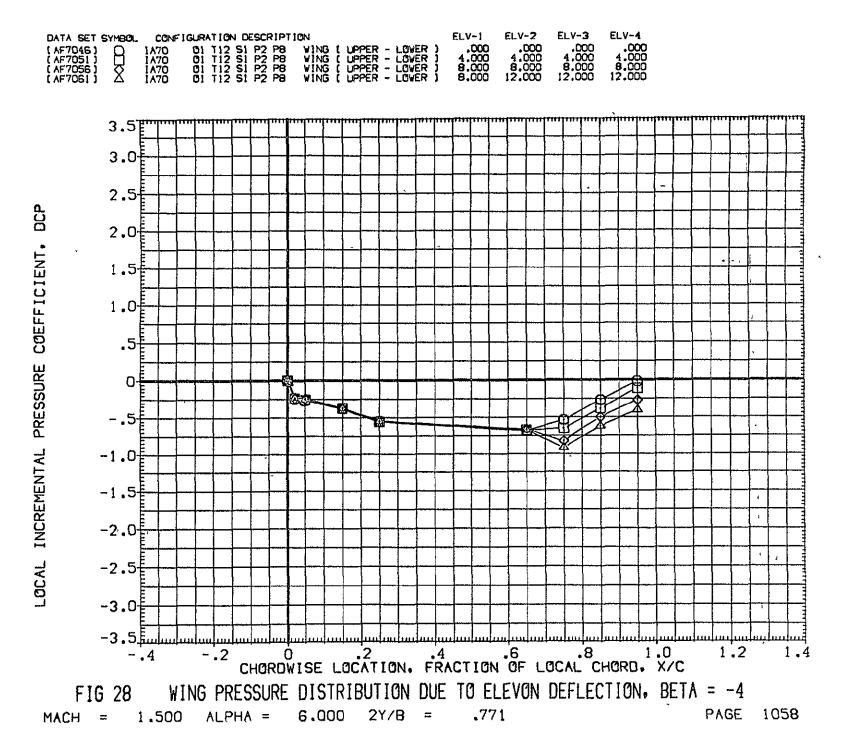


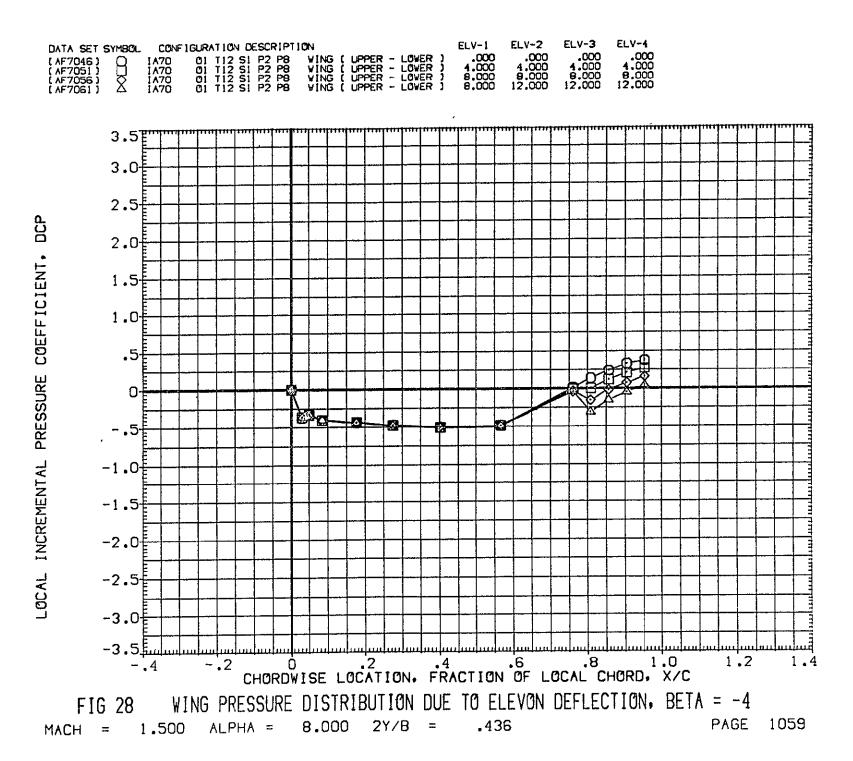


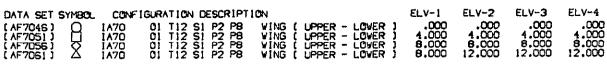


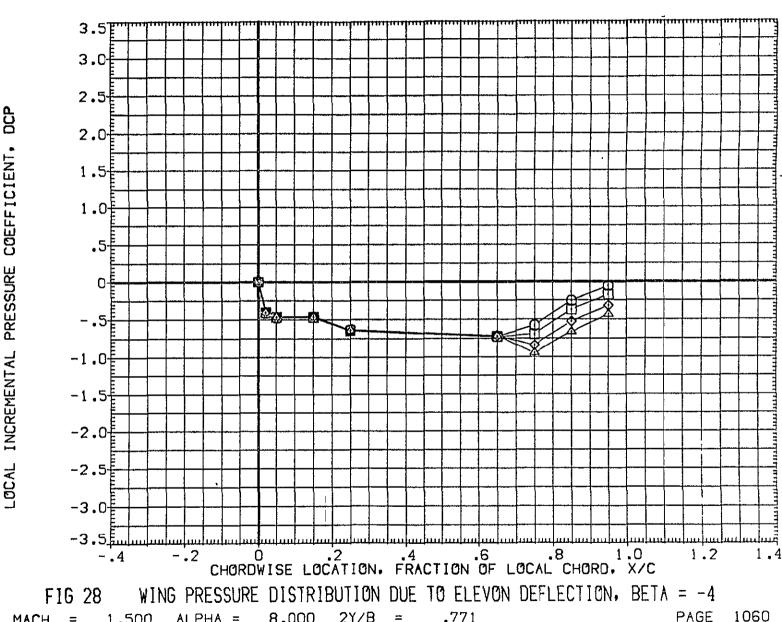




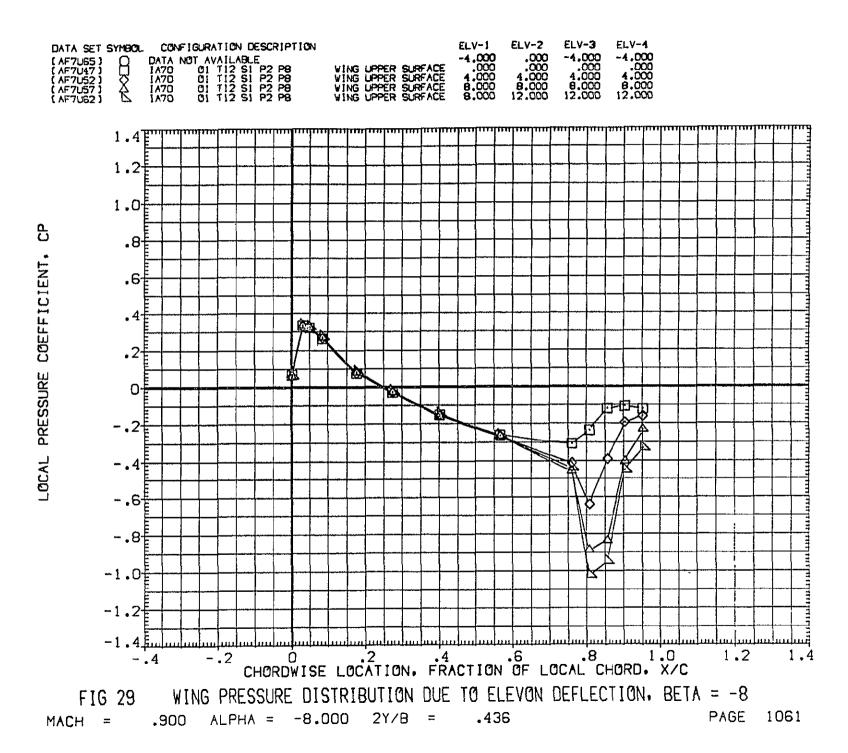


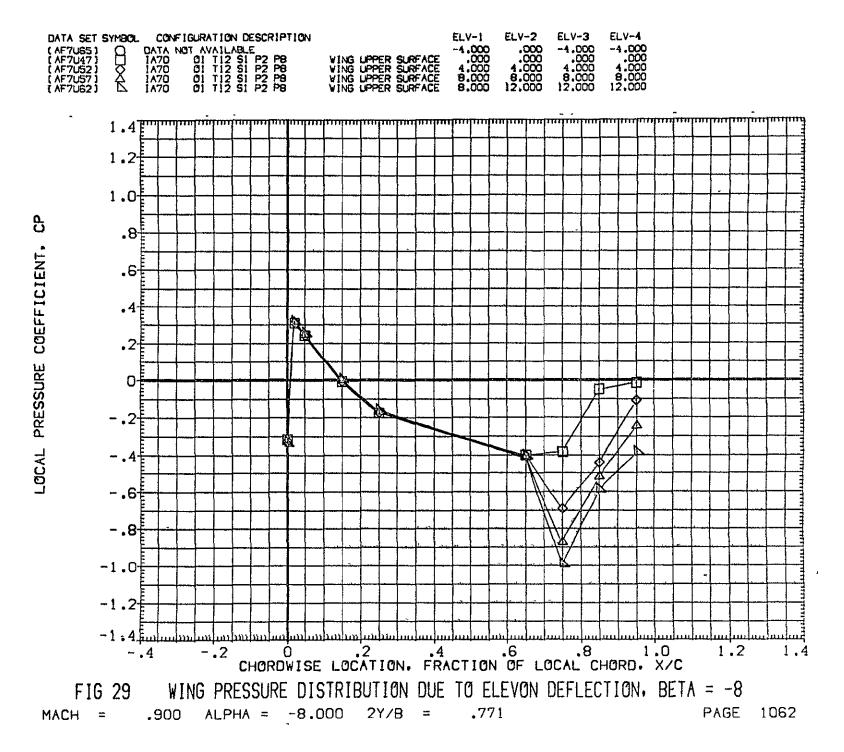


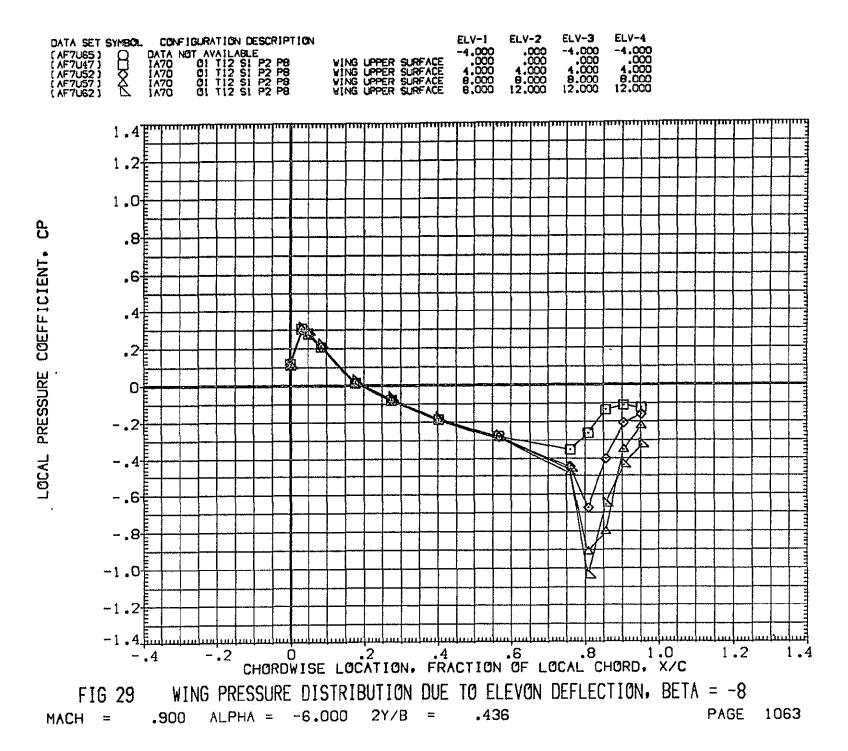


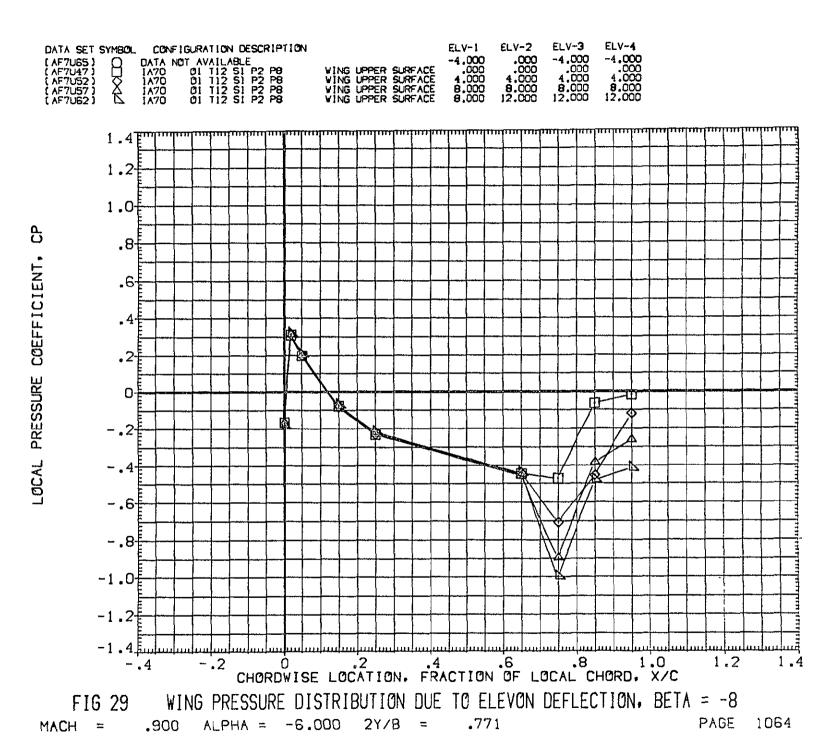


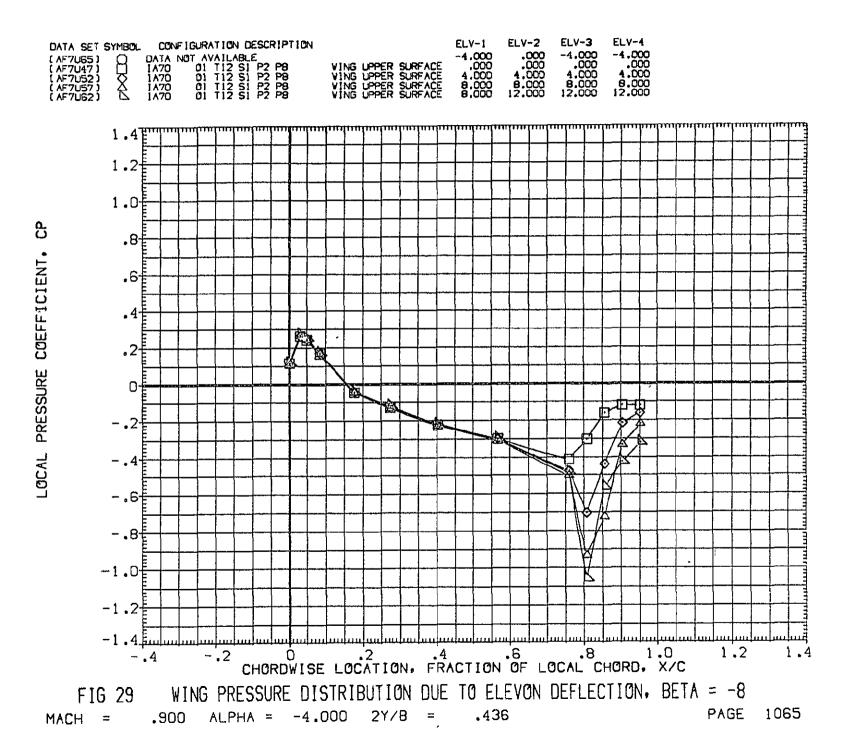
MACH = 1.500 ALPHA = 8.000 2Y/B = .771 PAGE

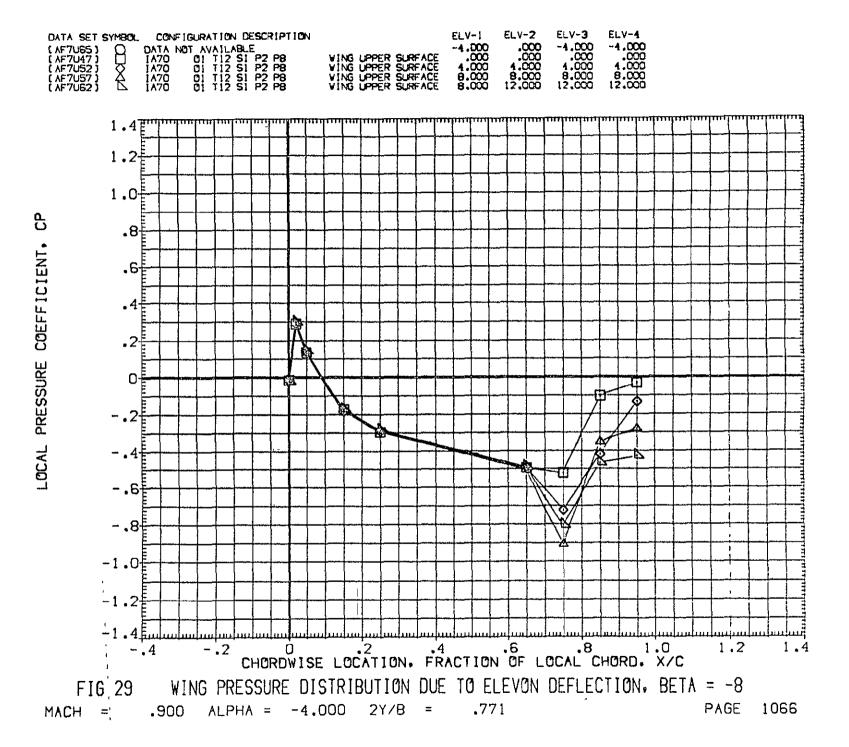


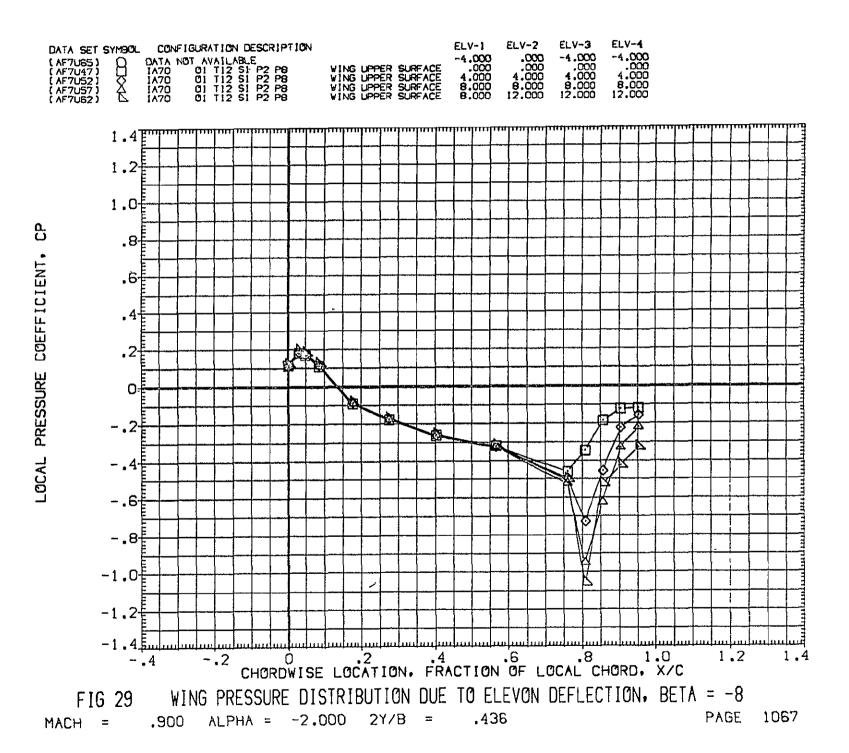


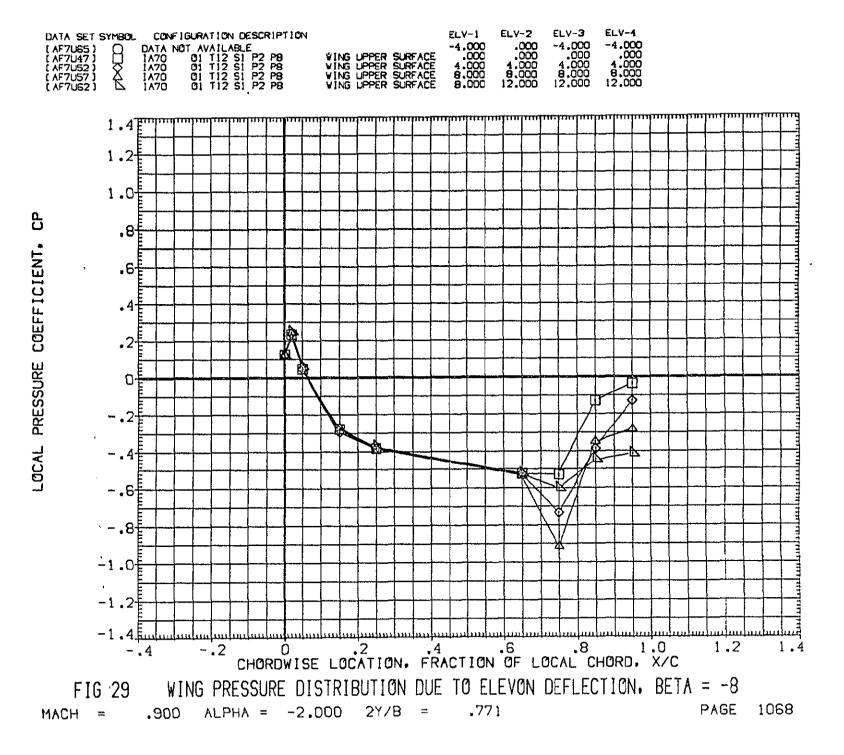


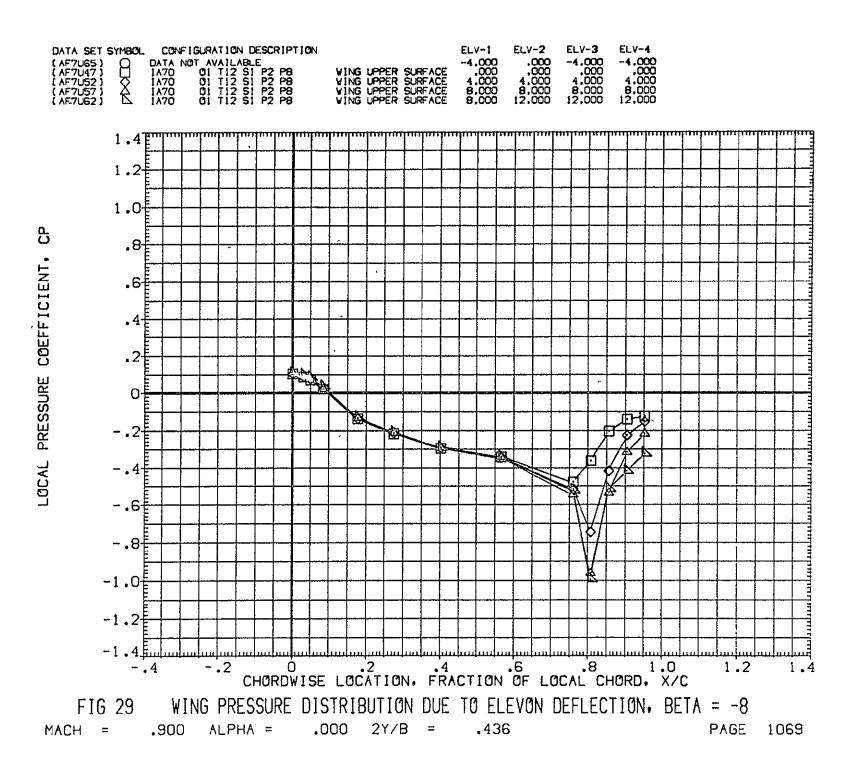


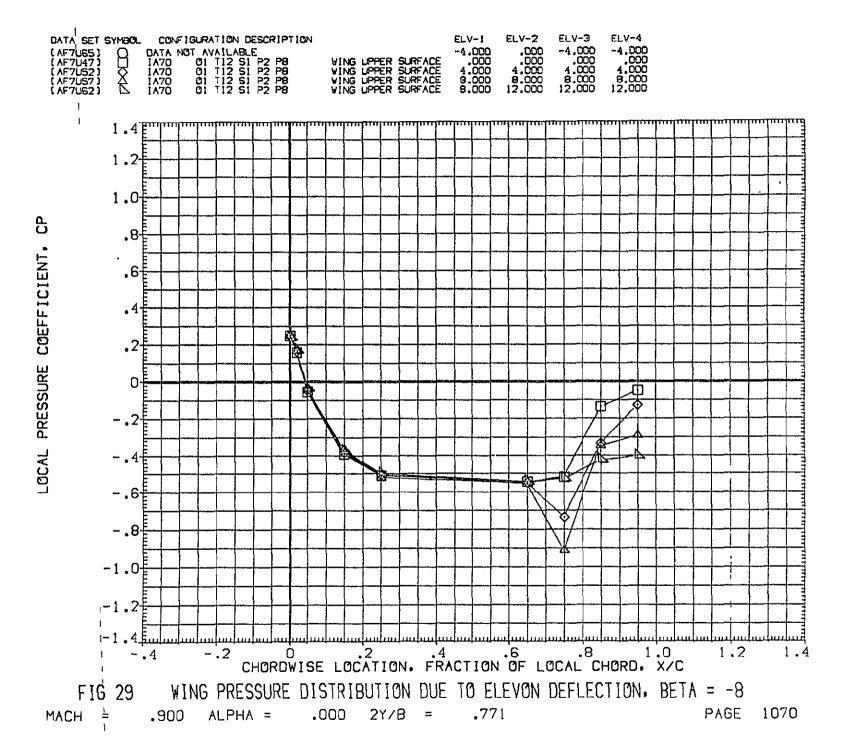


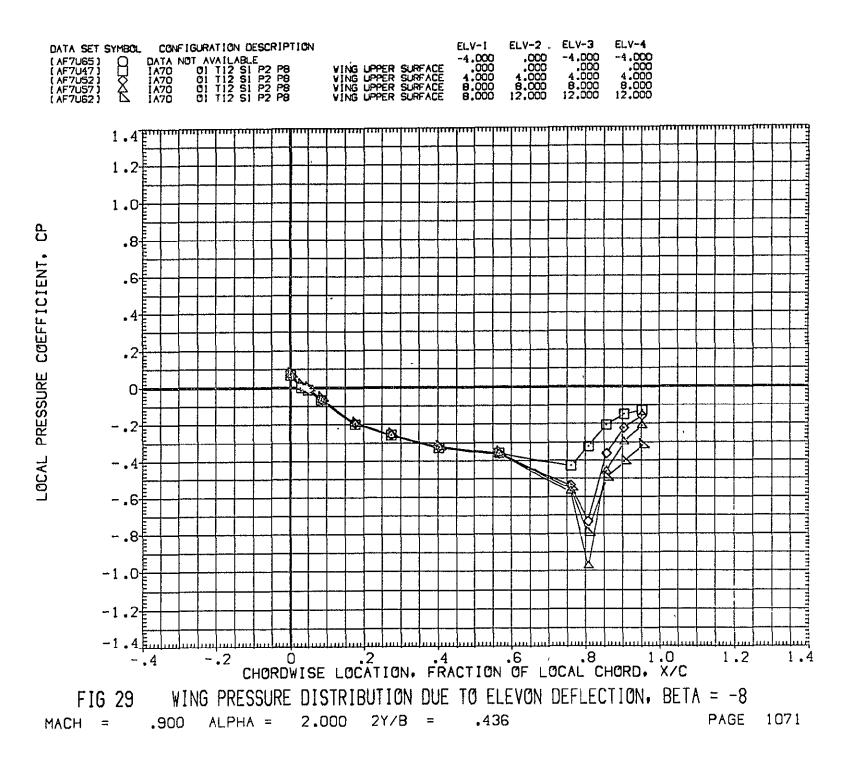


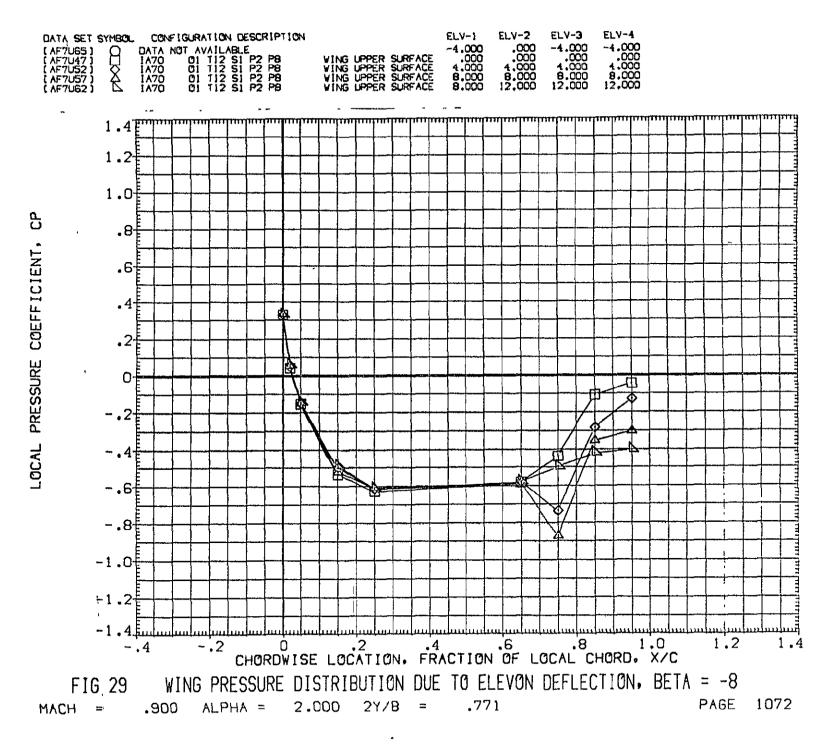


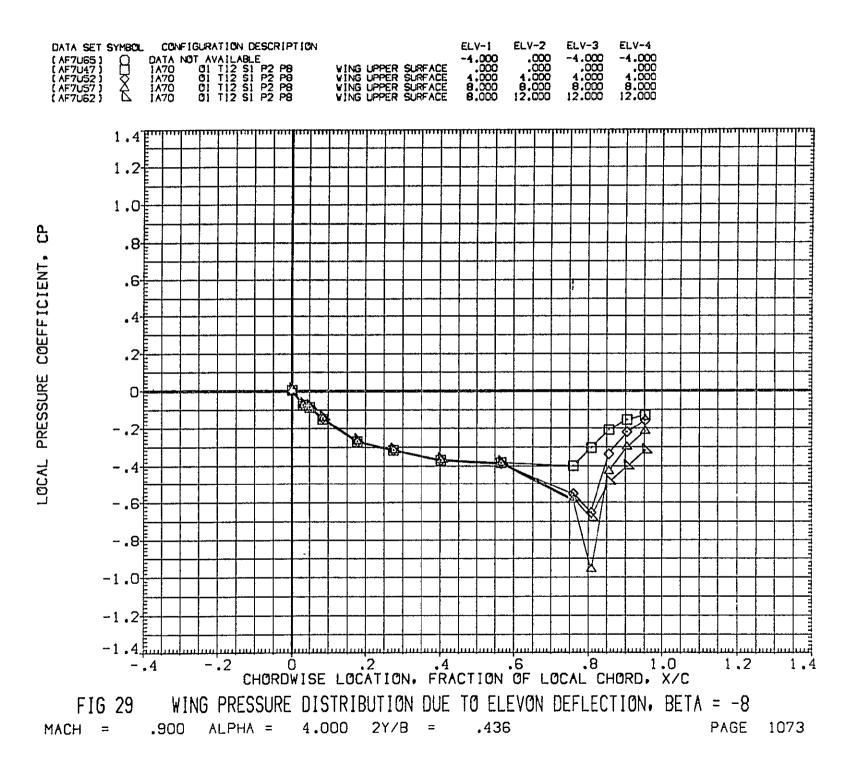


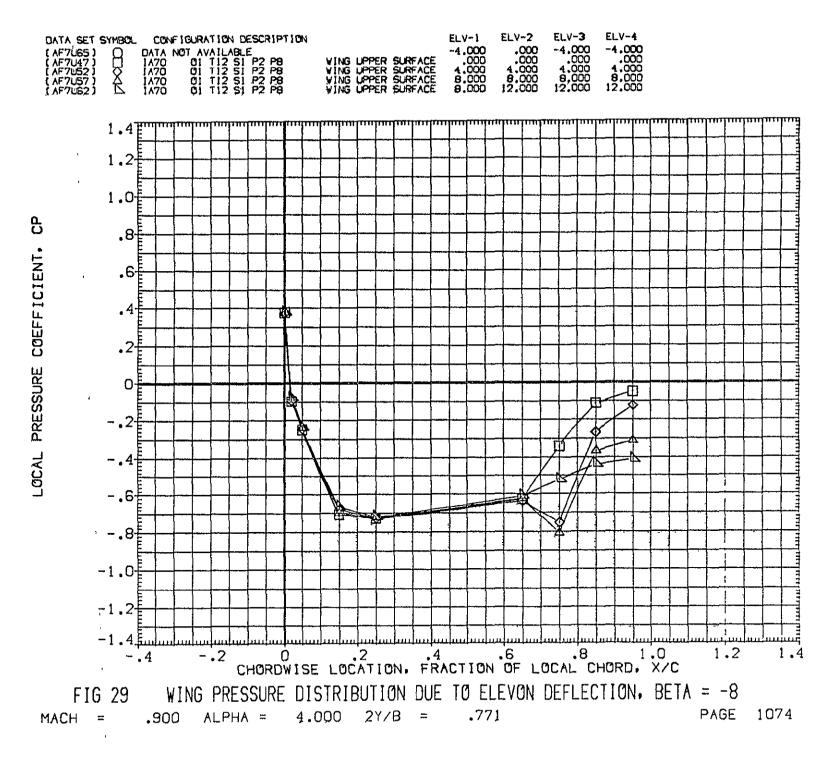


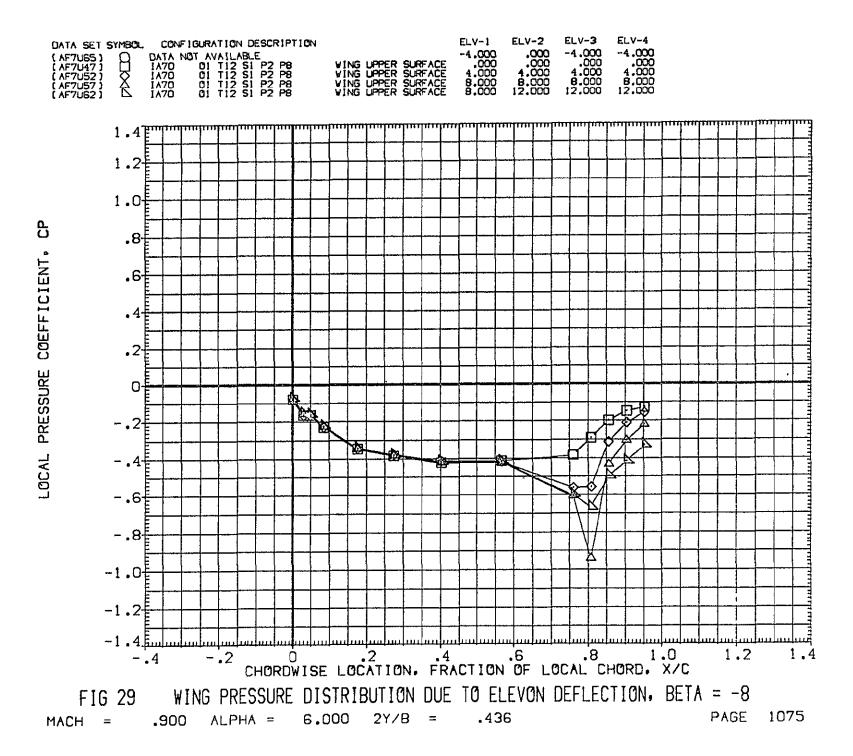


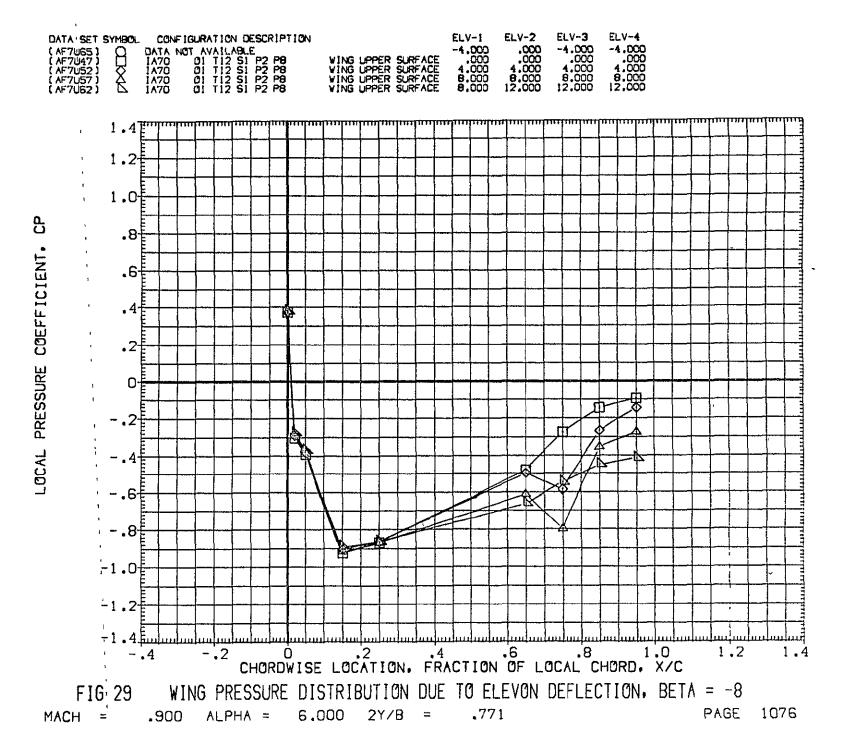


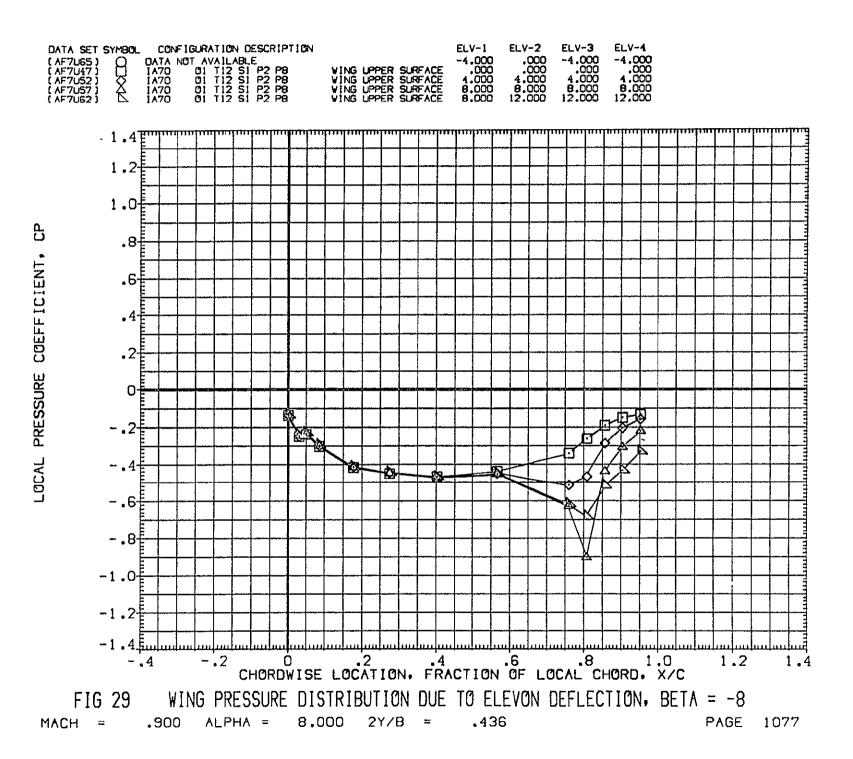


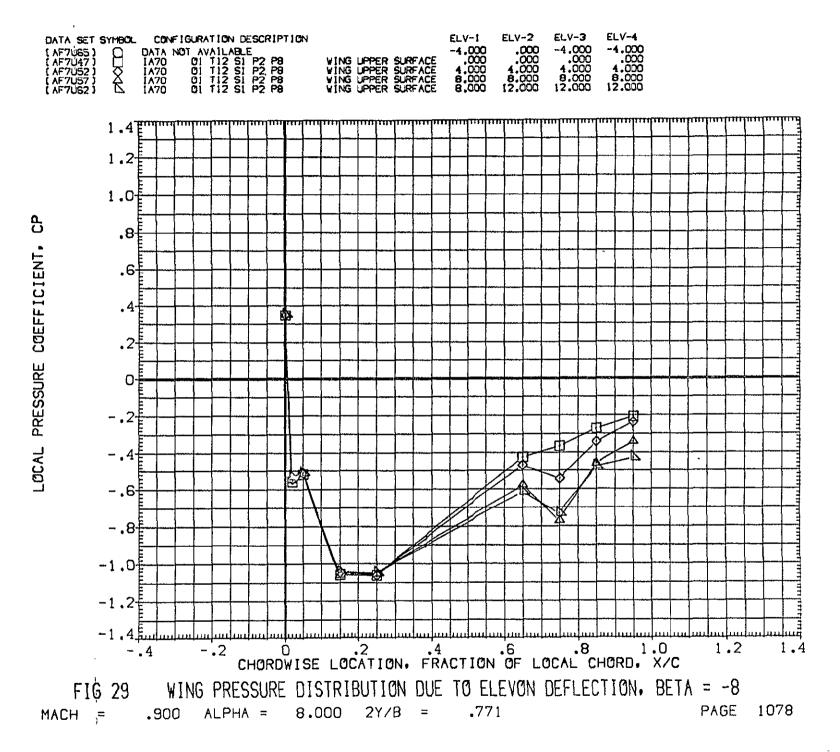


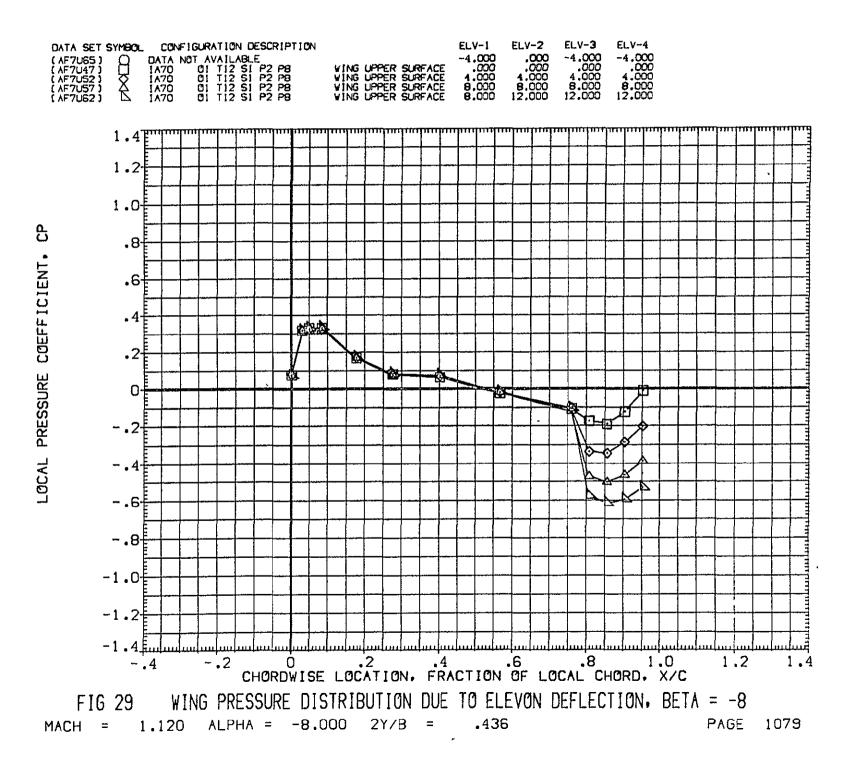


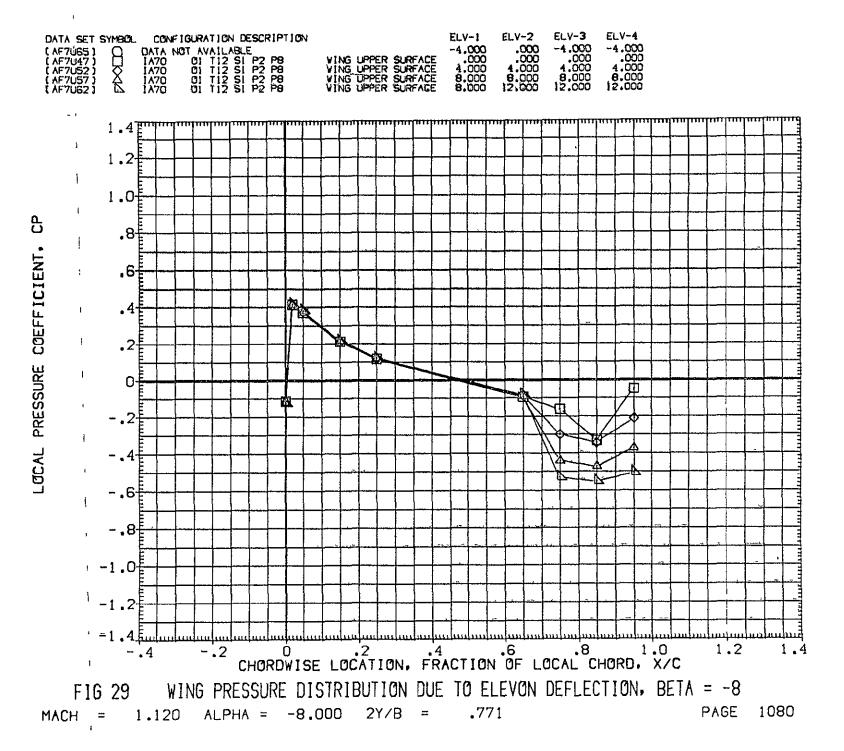


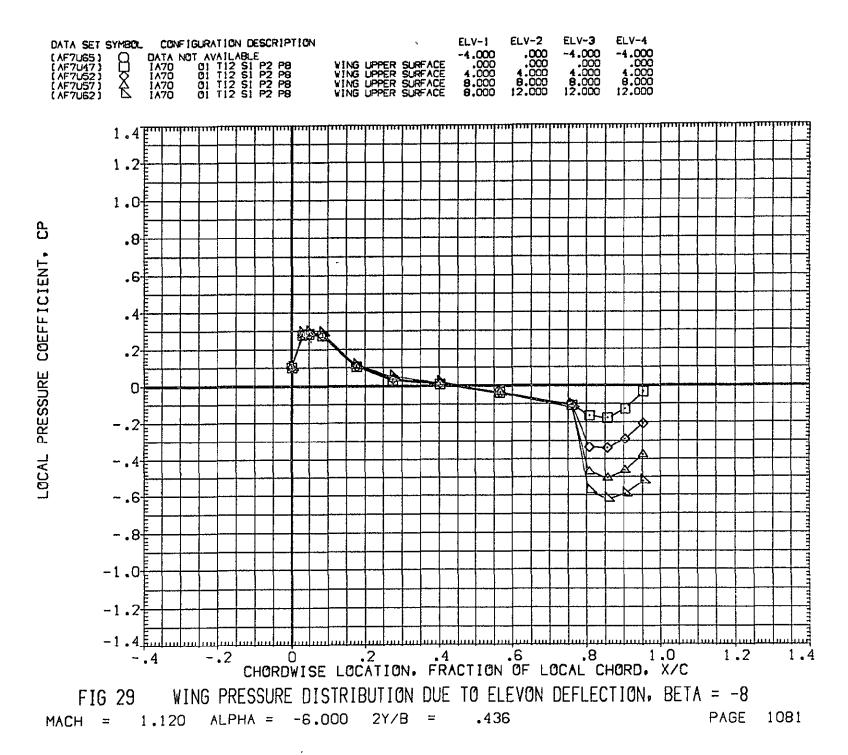


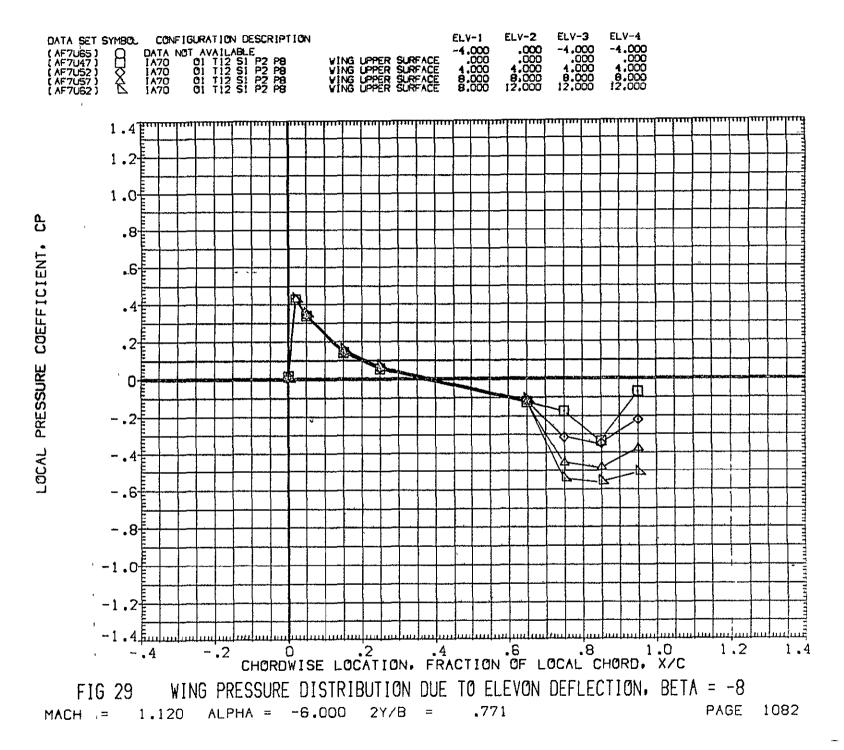


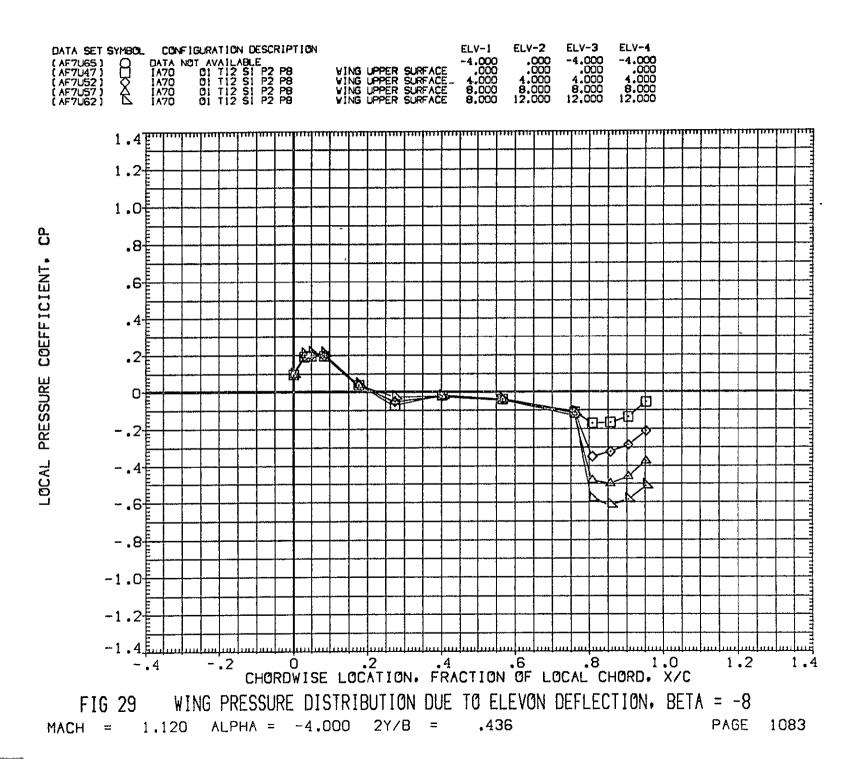


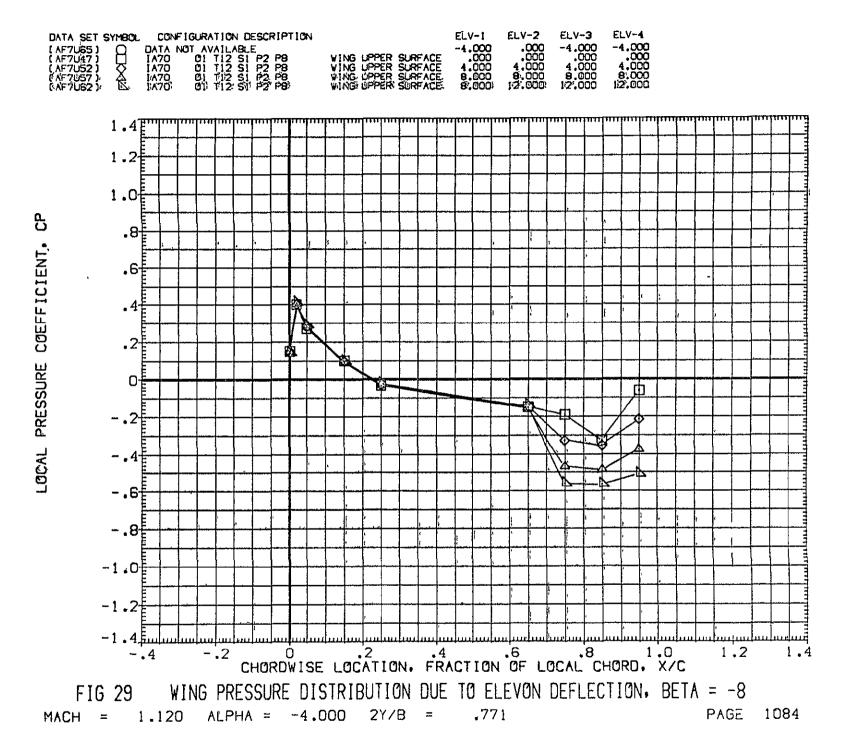


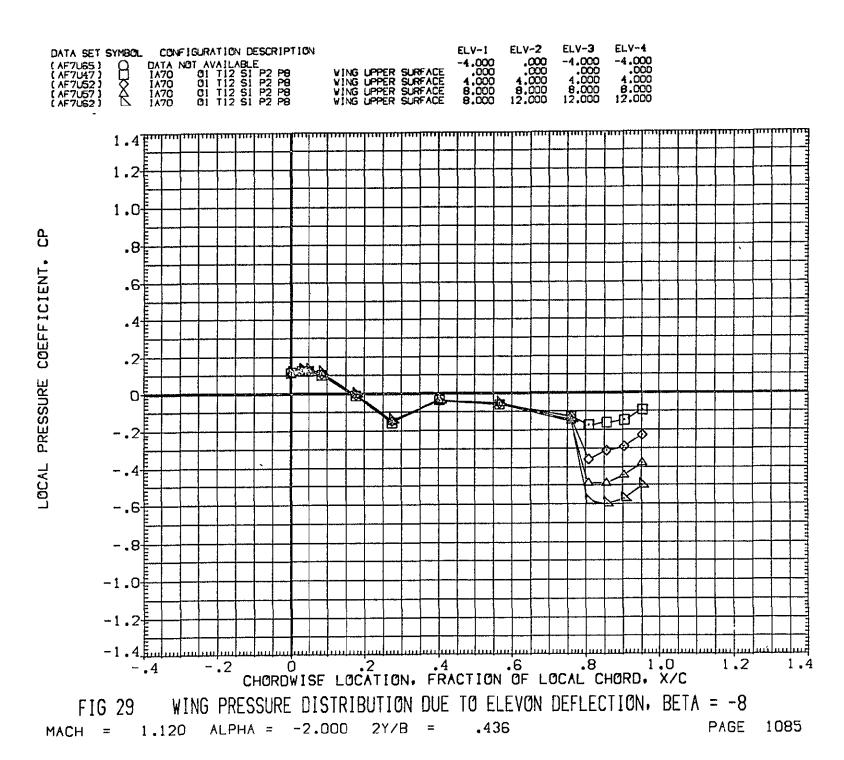


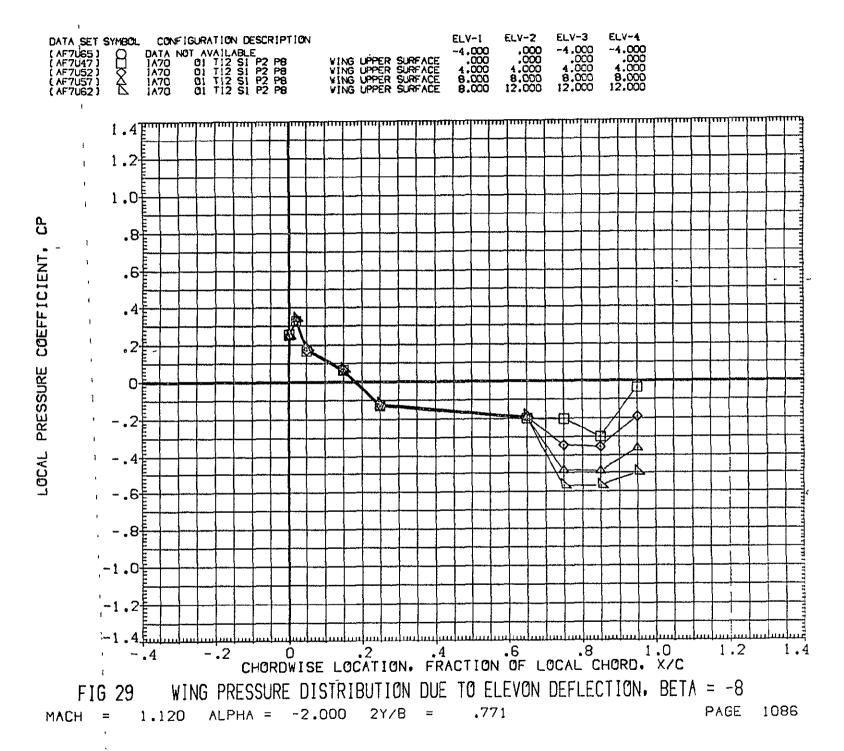


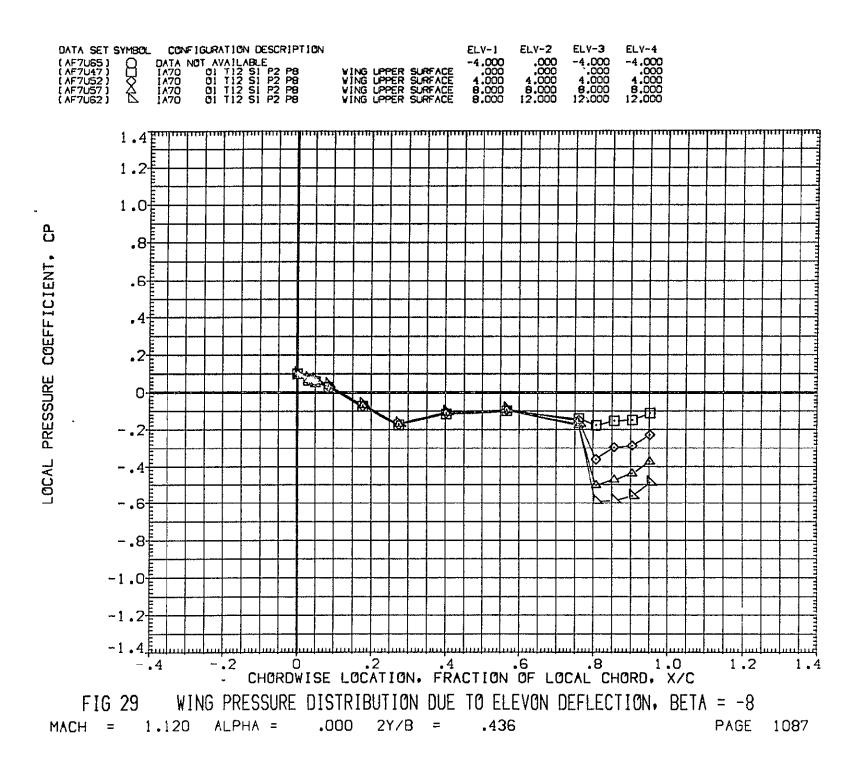


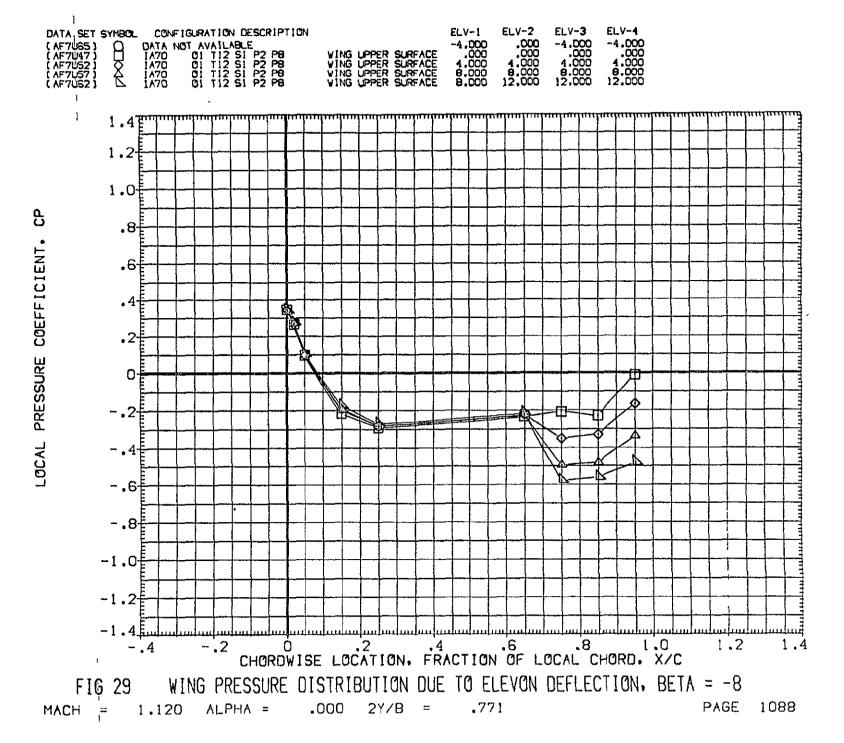


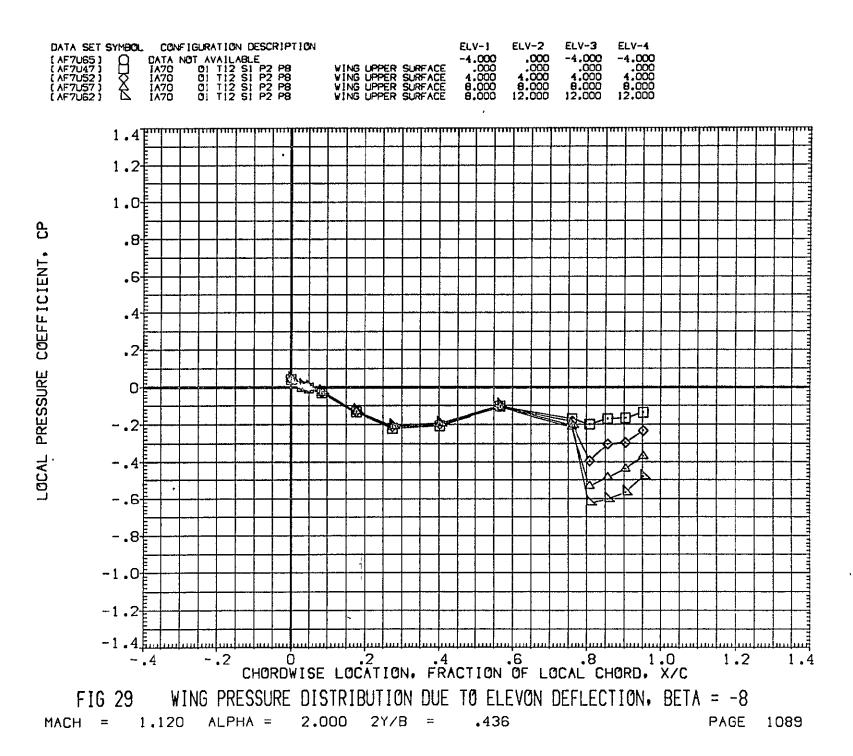


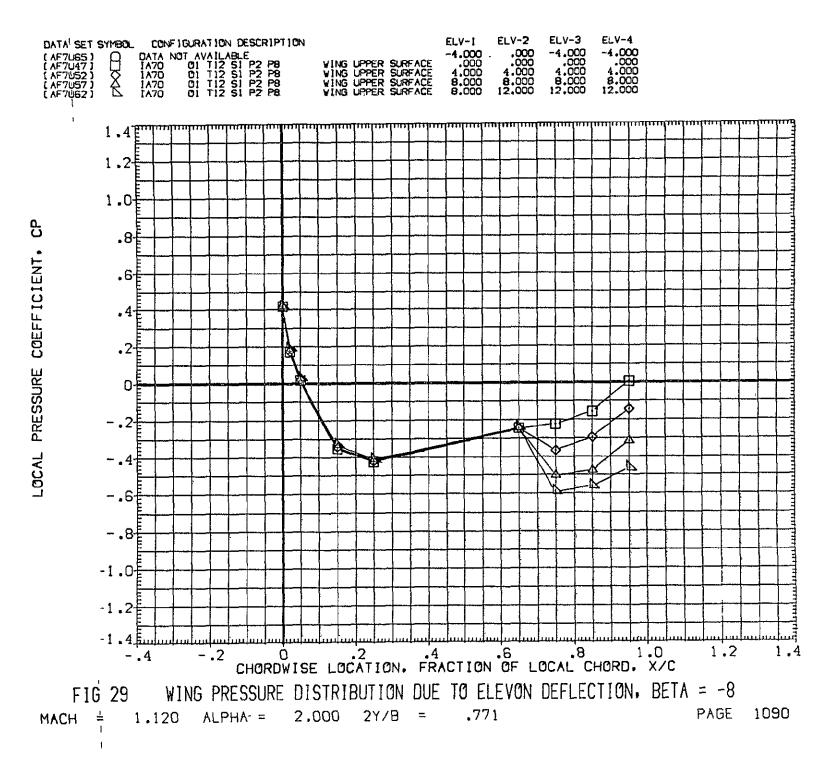


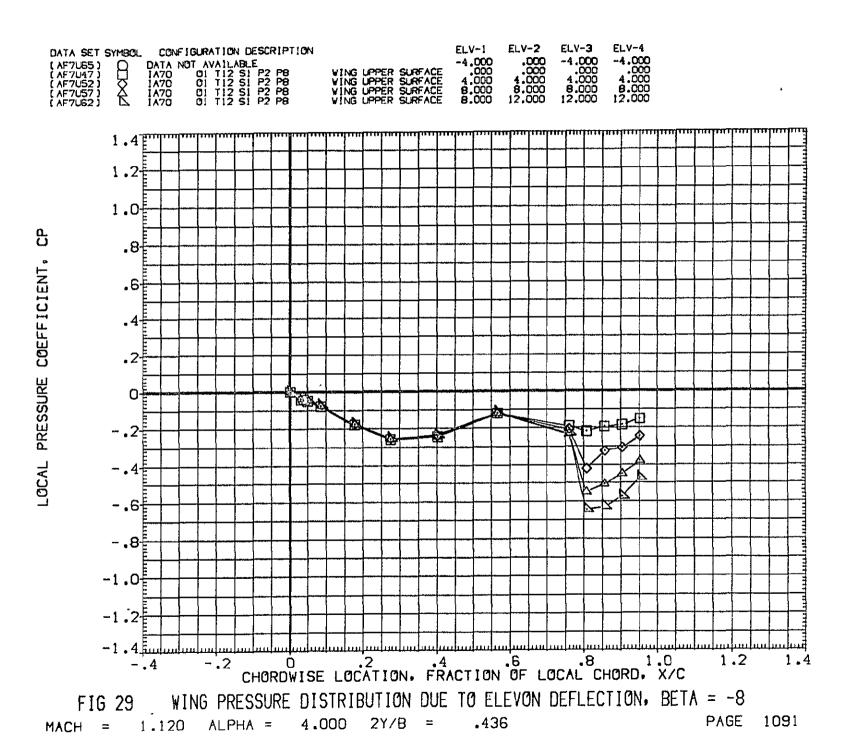


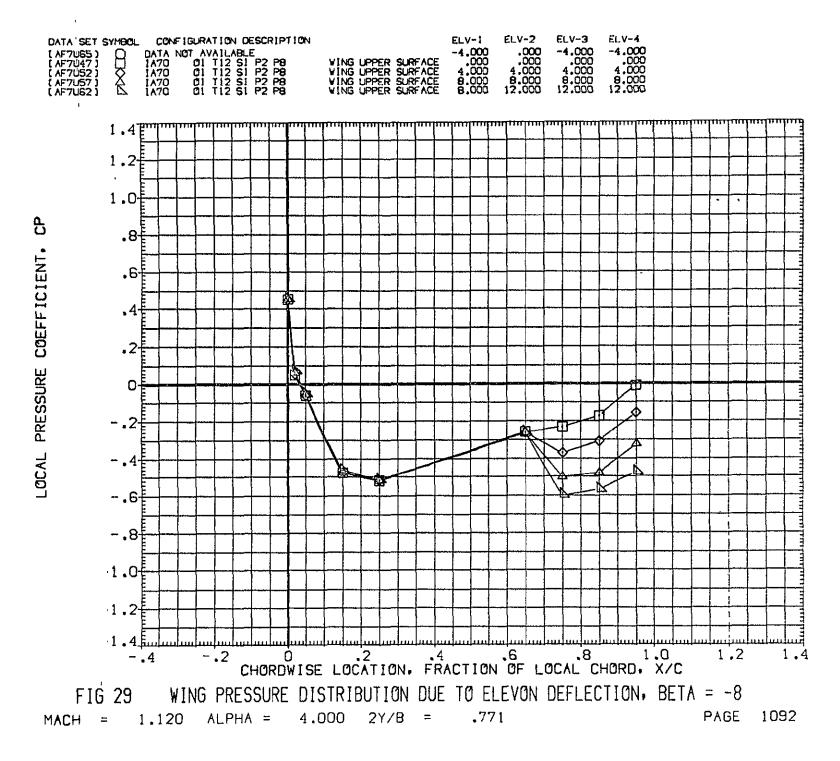


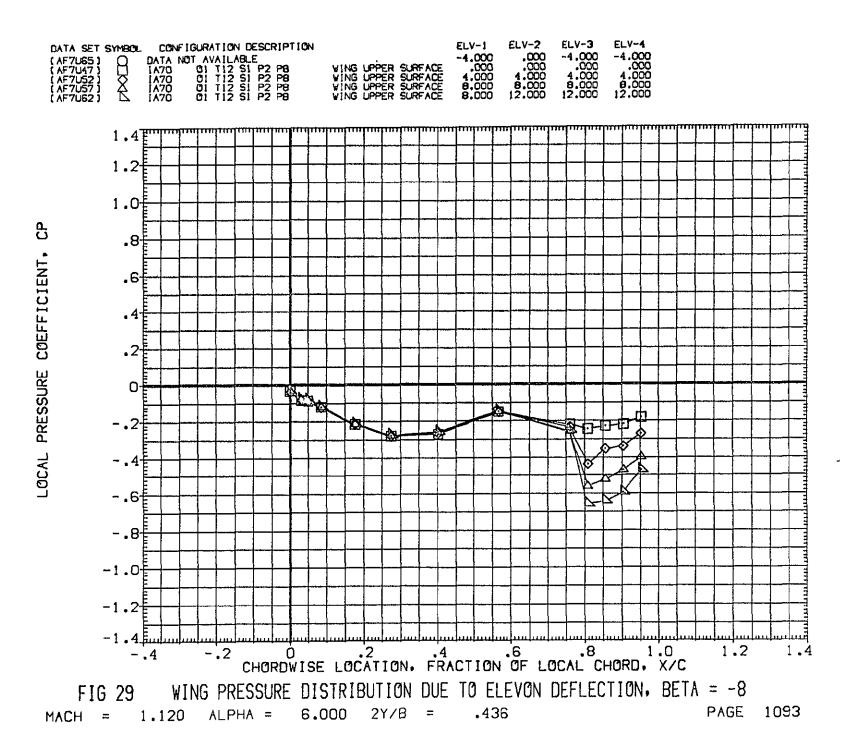


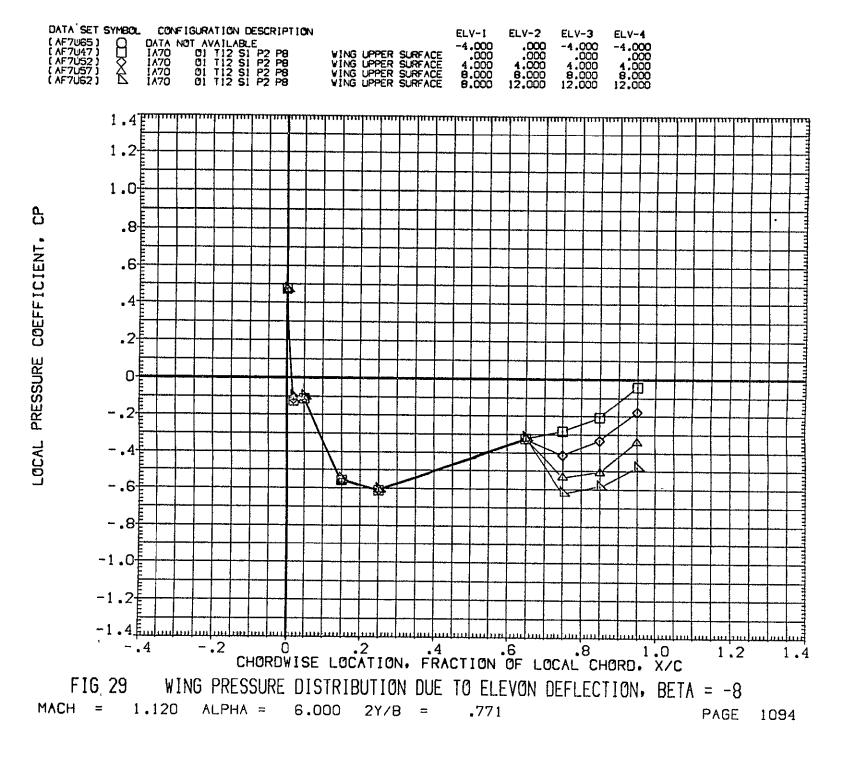


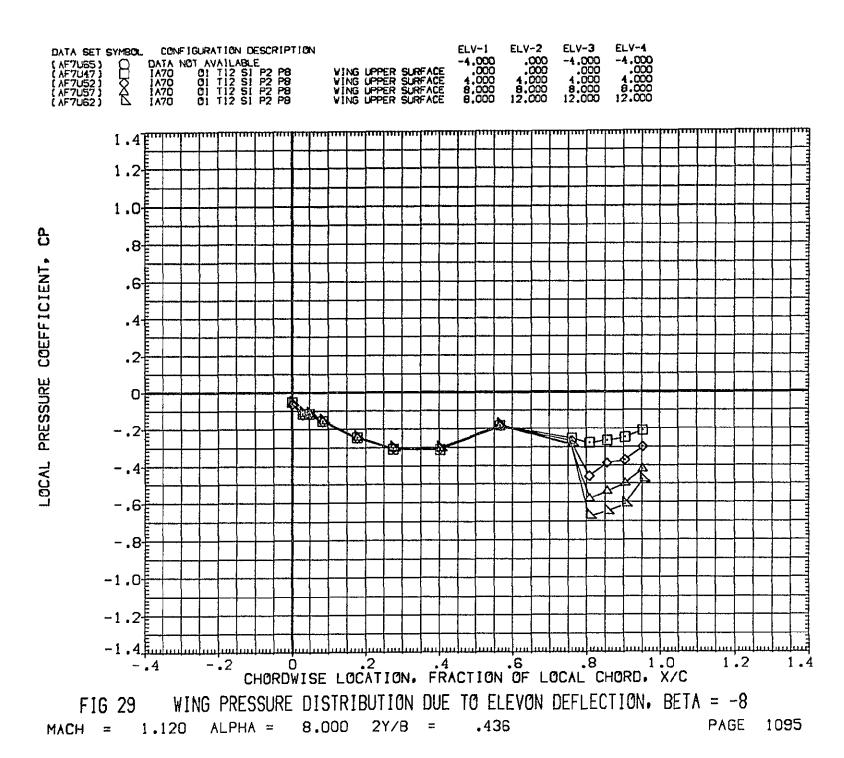


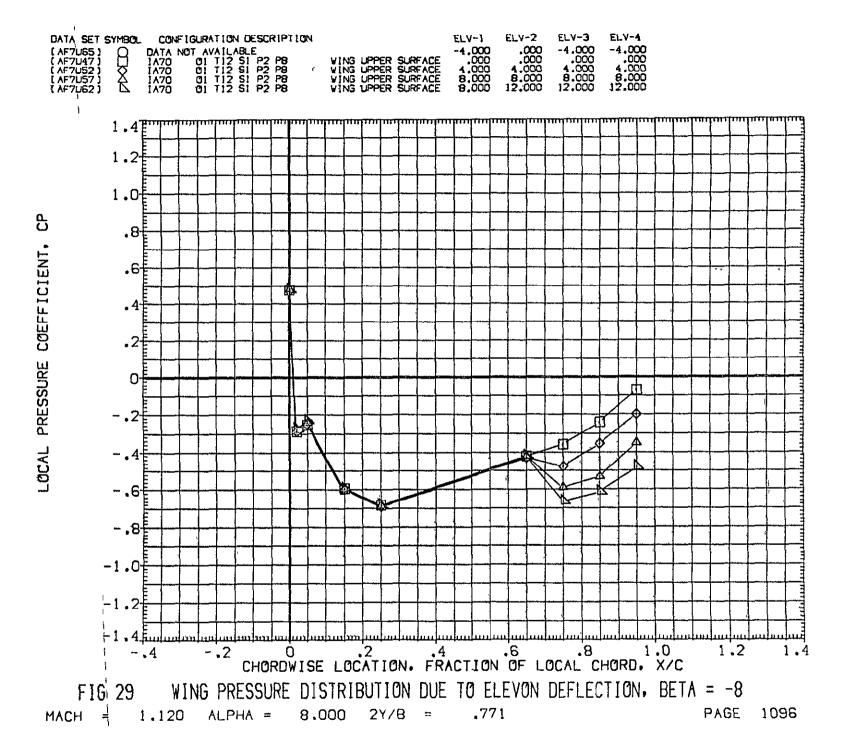


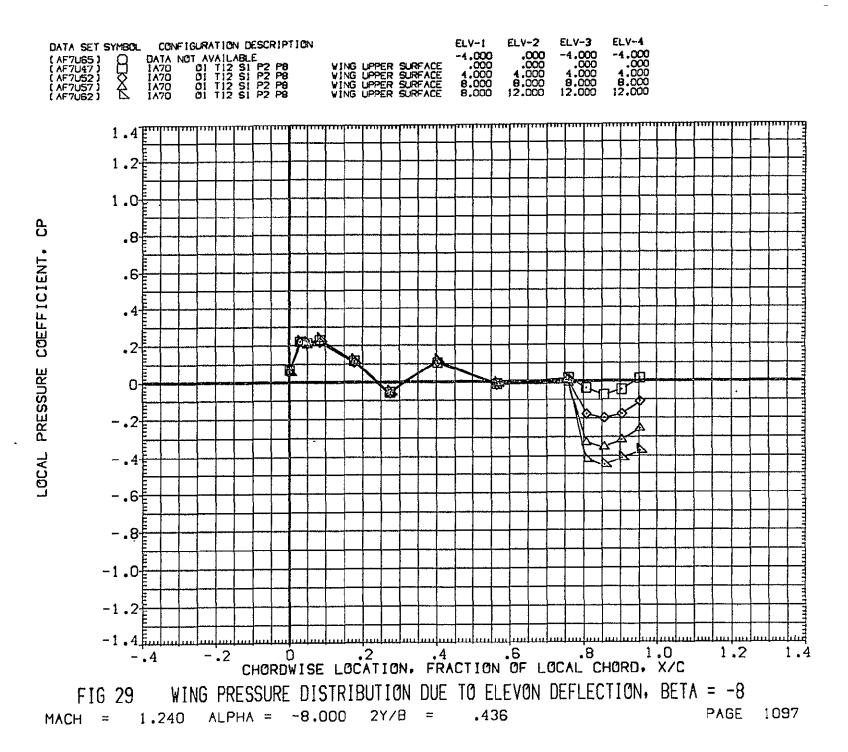


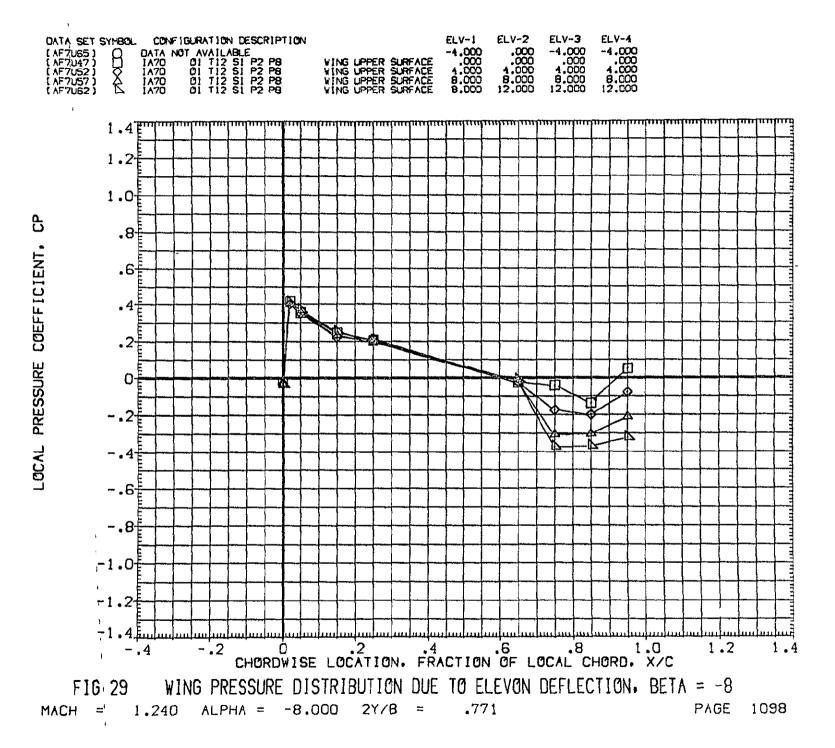


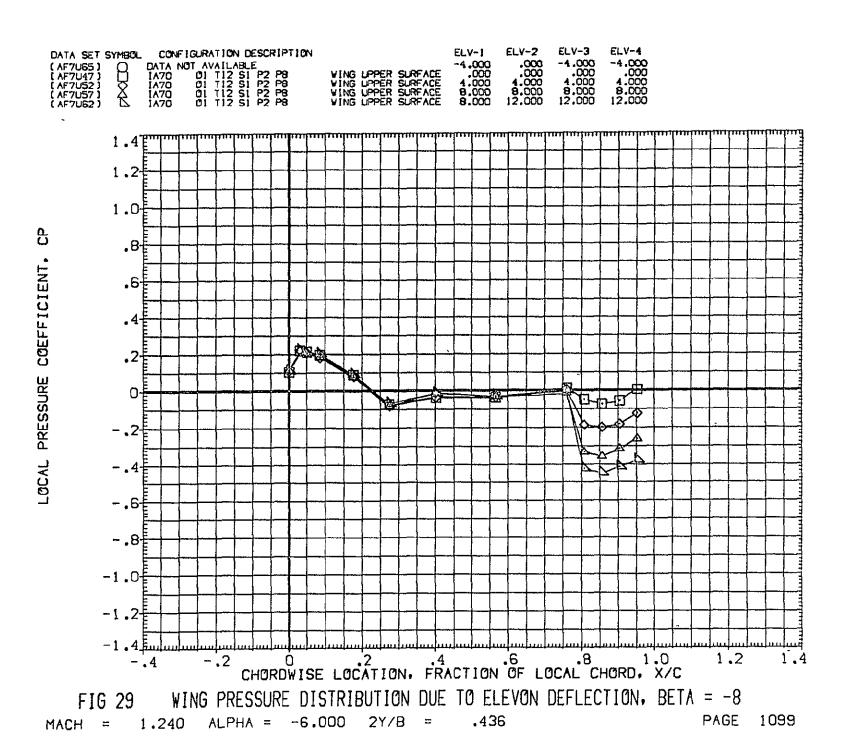


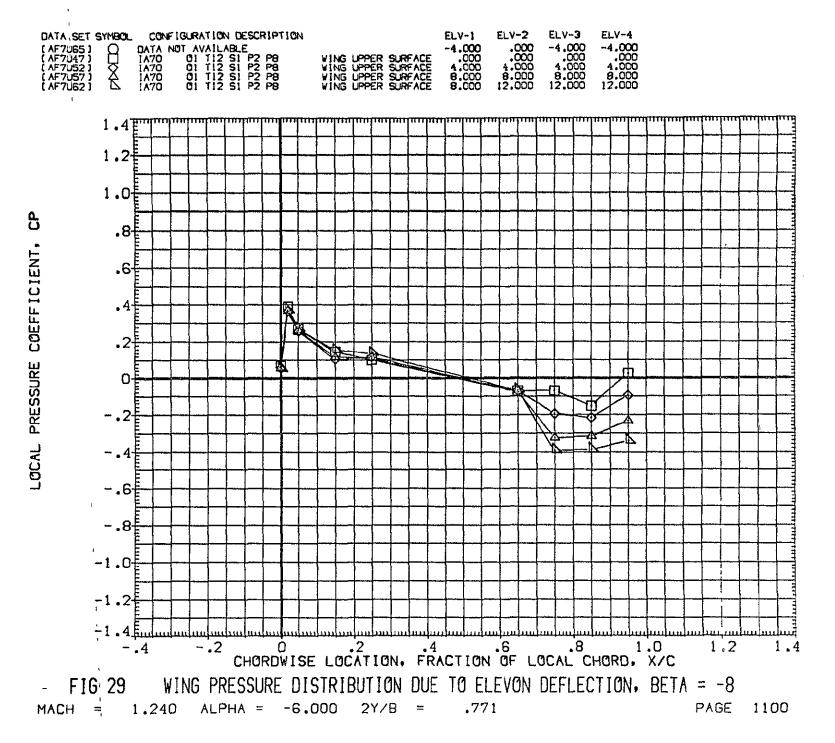


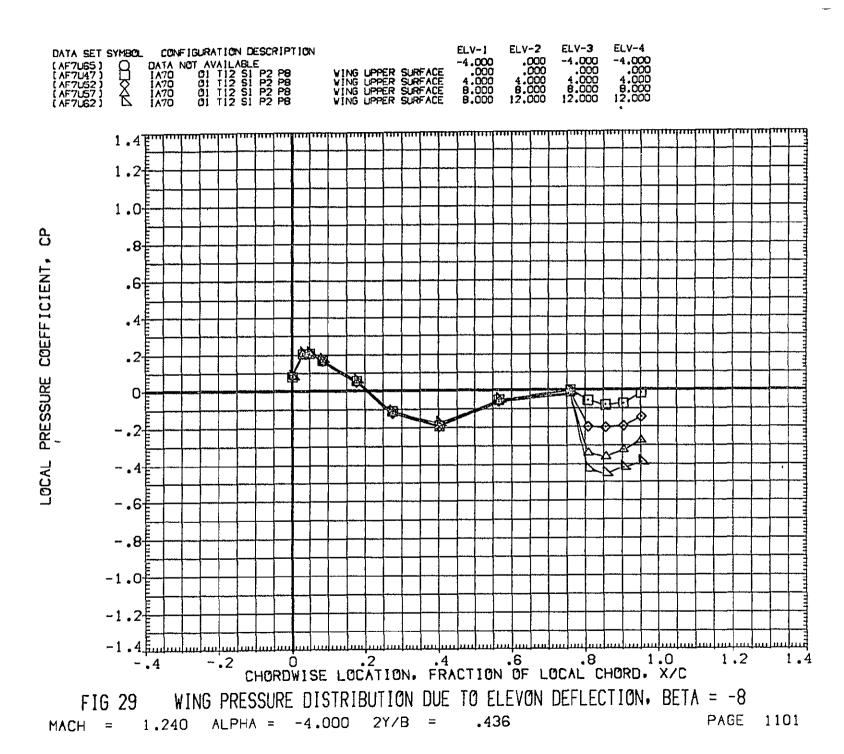


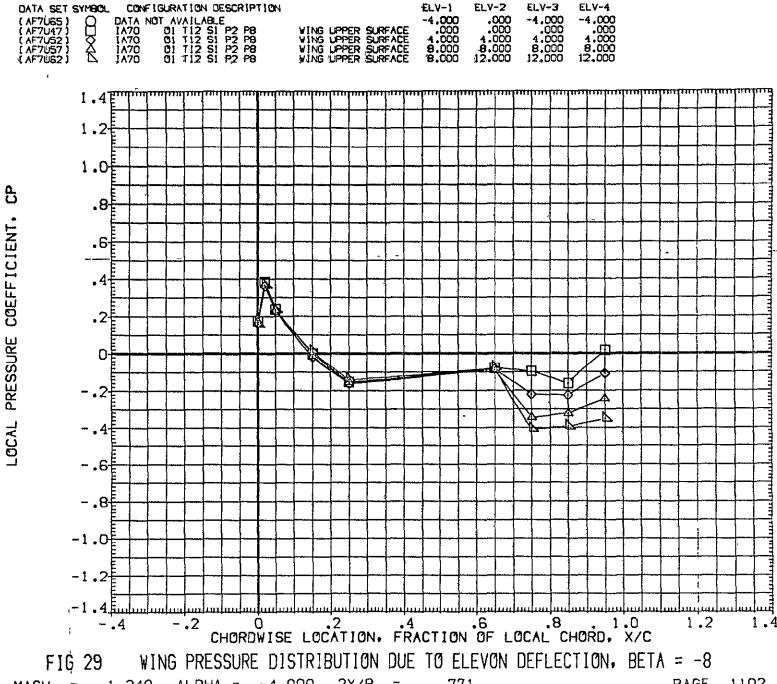




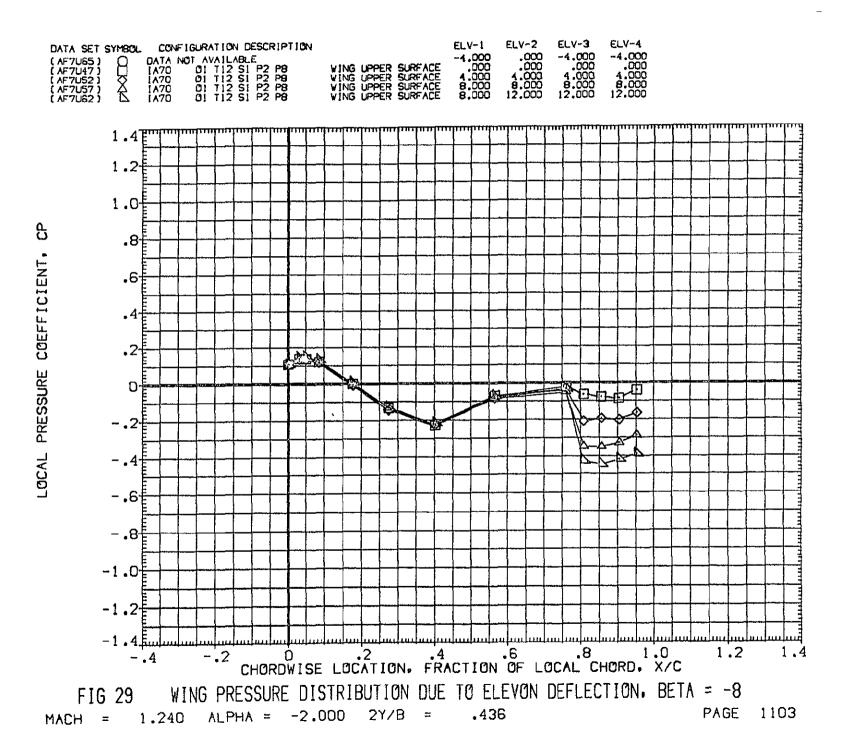


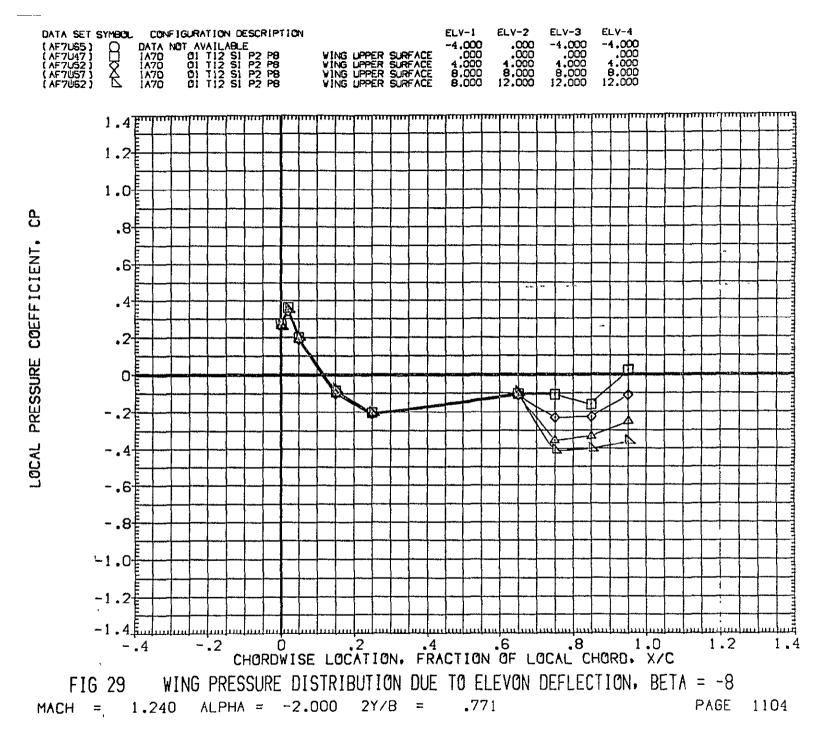


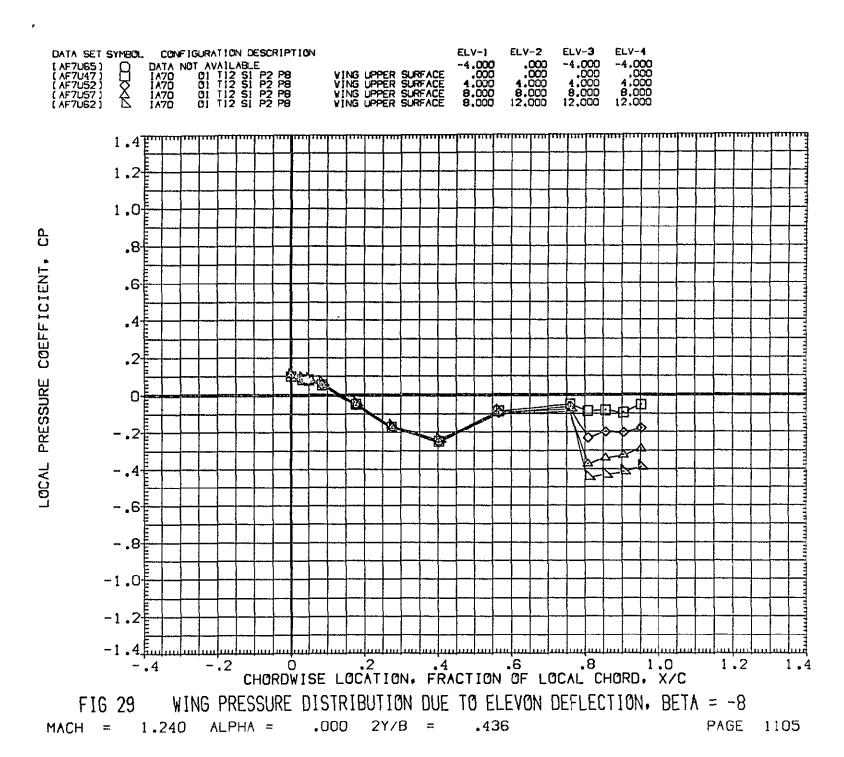


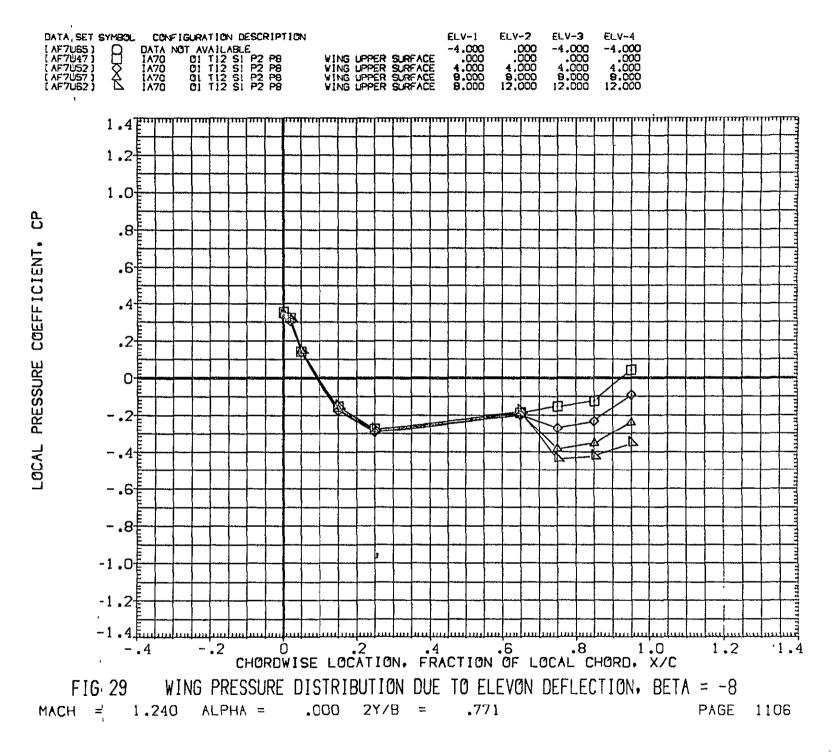


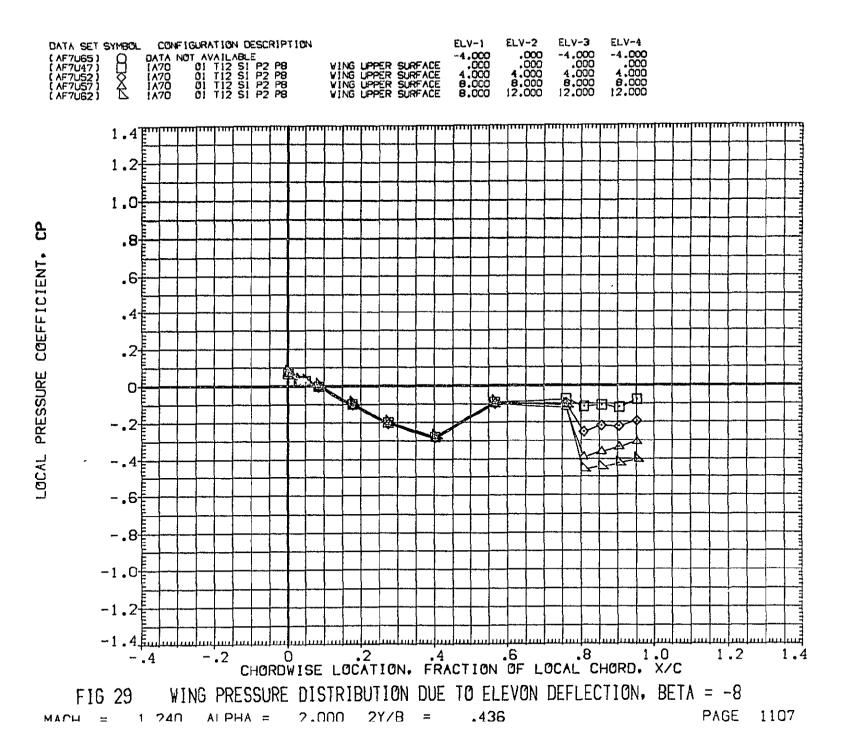
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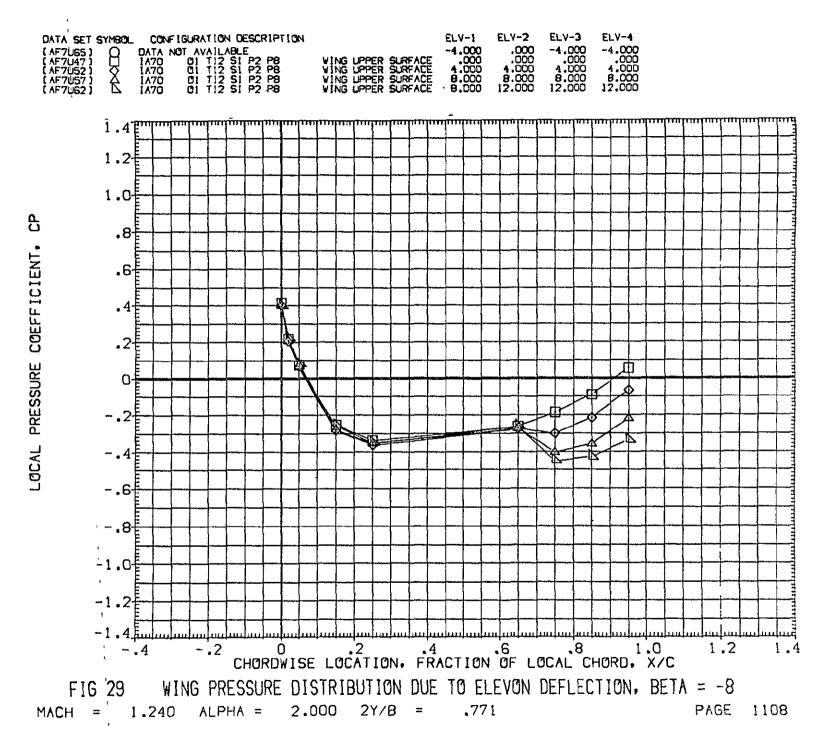


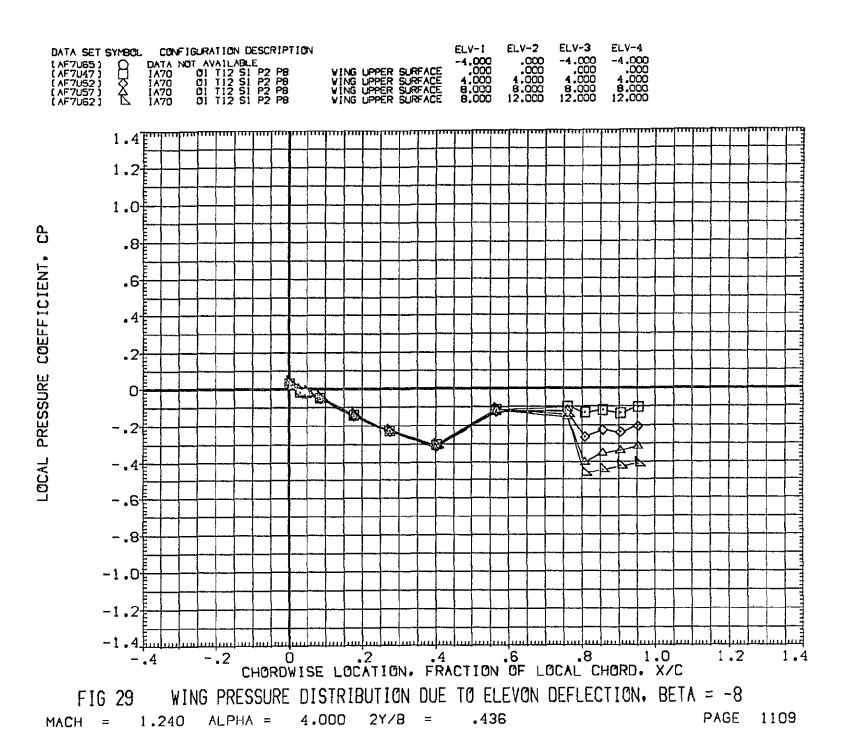


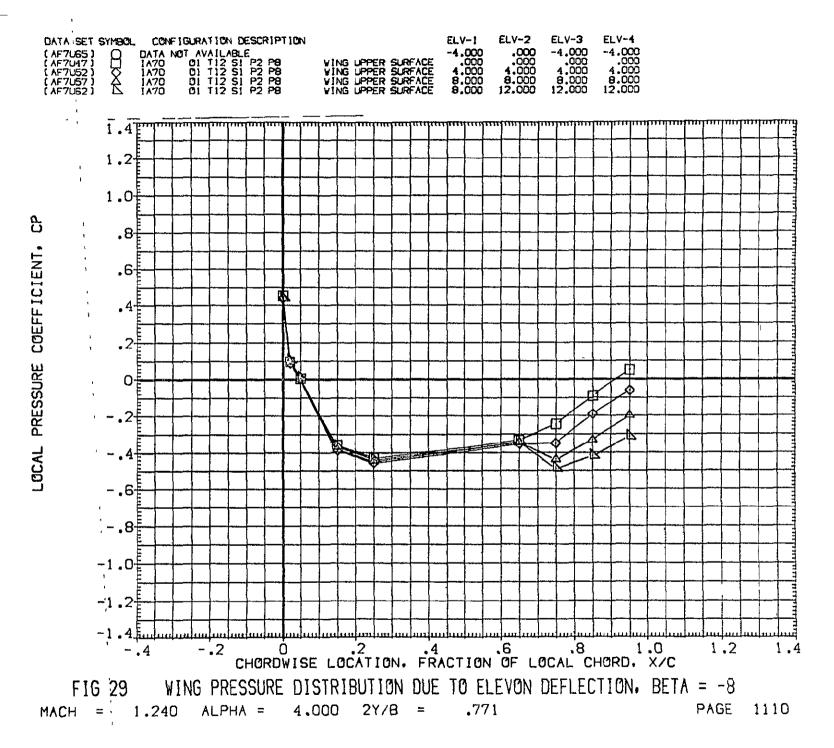


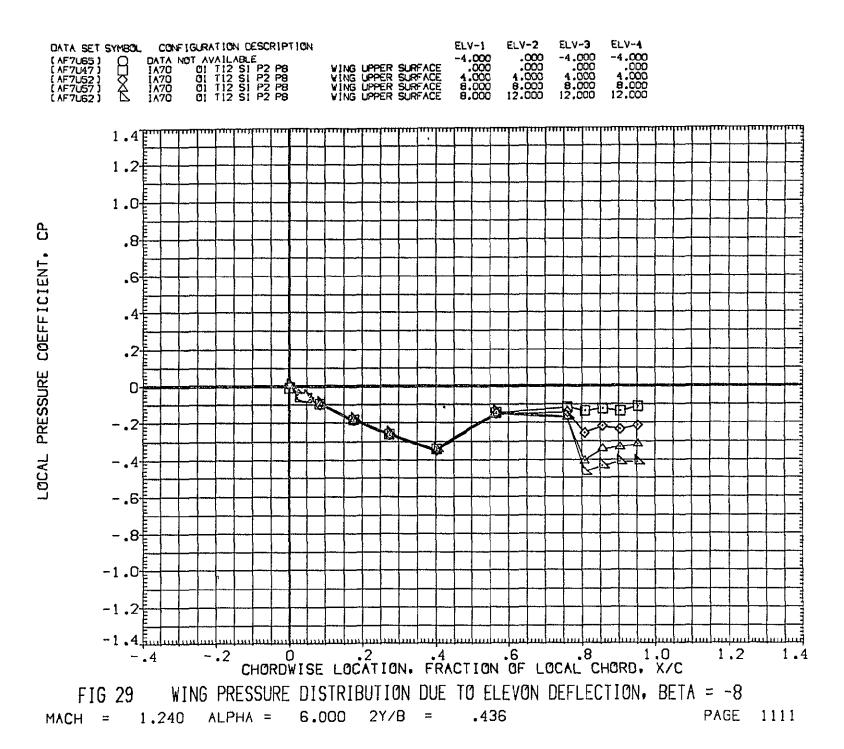


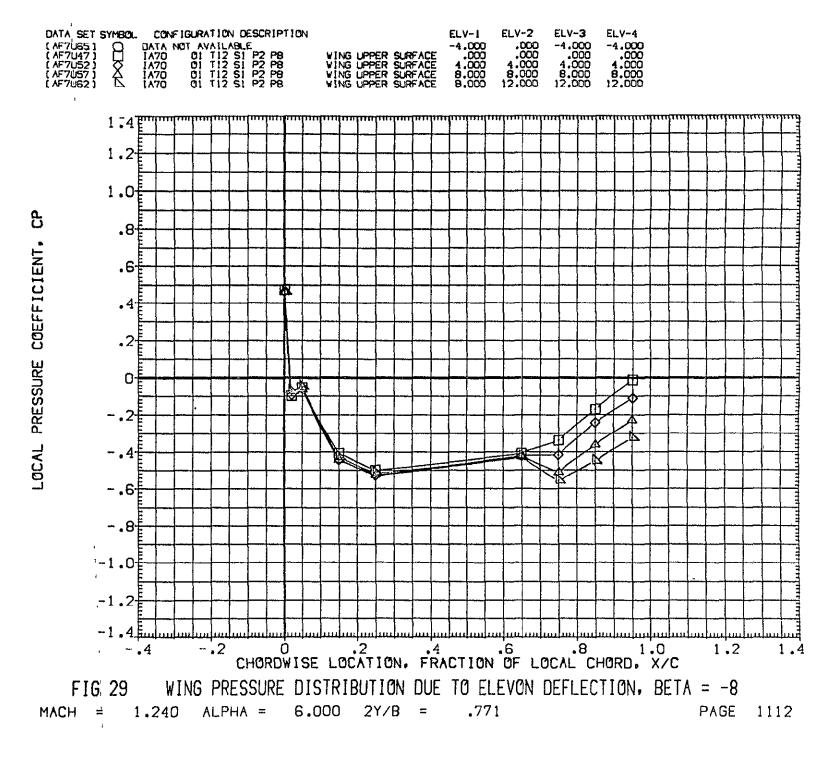


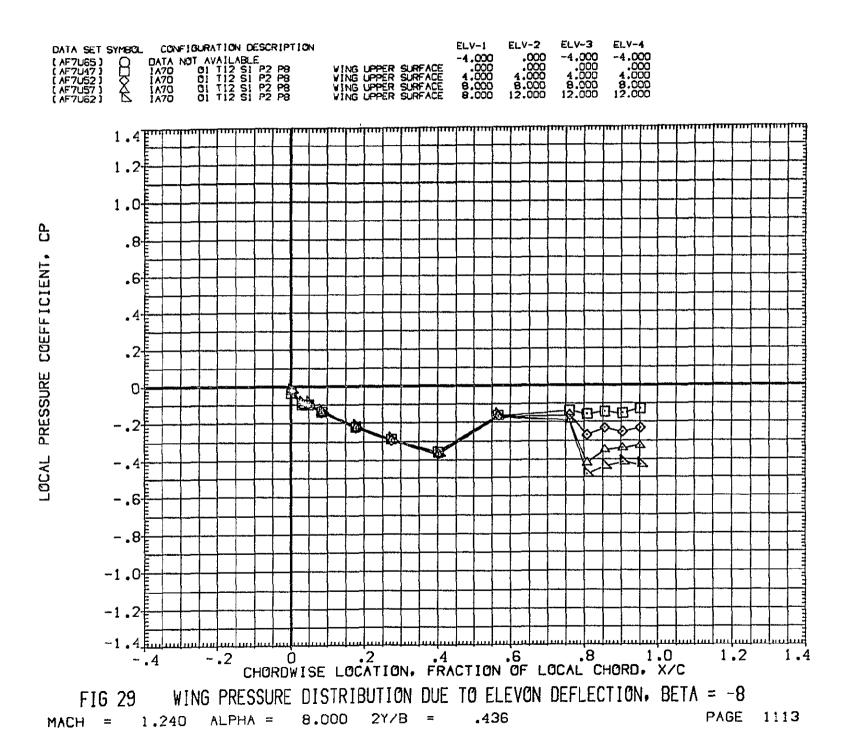


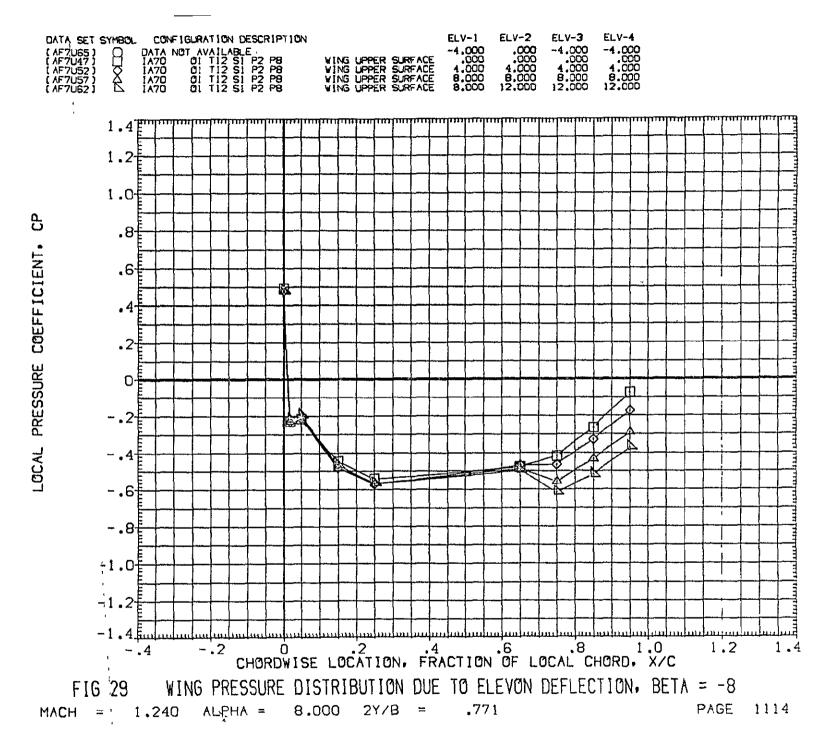


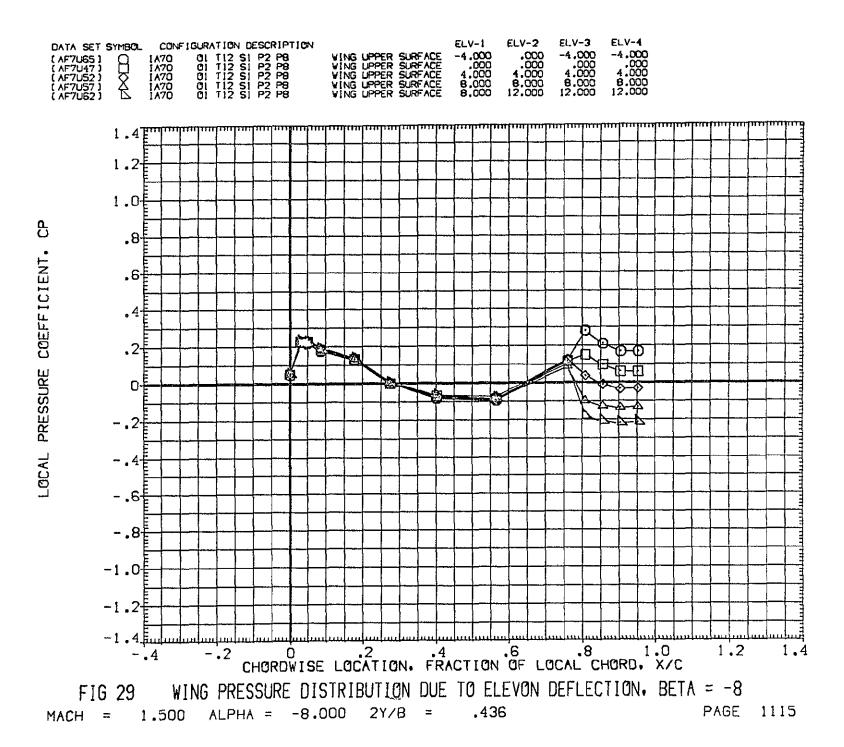


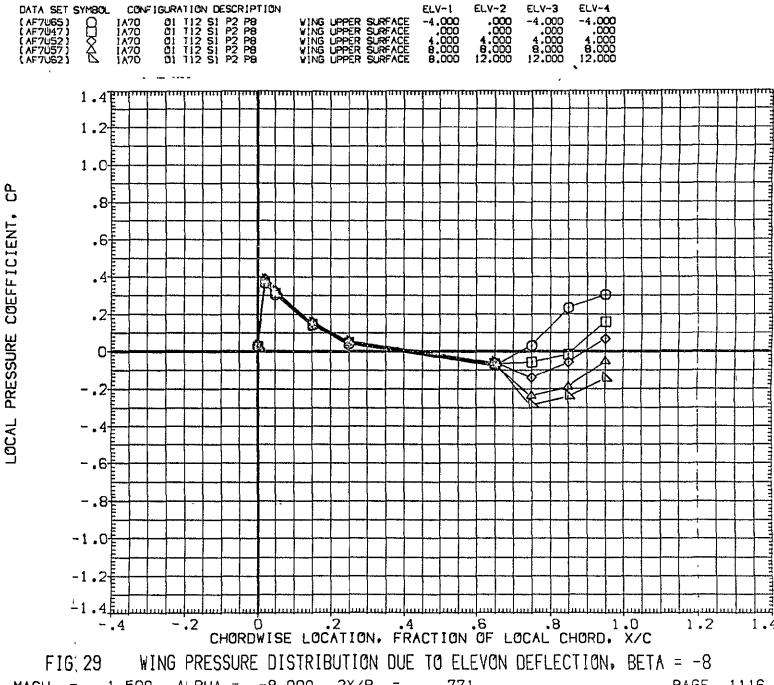




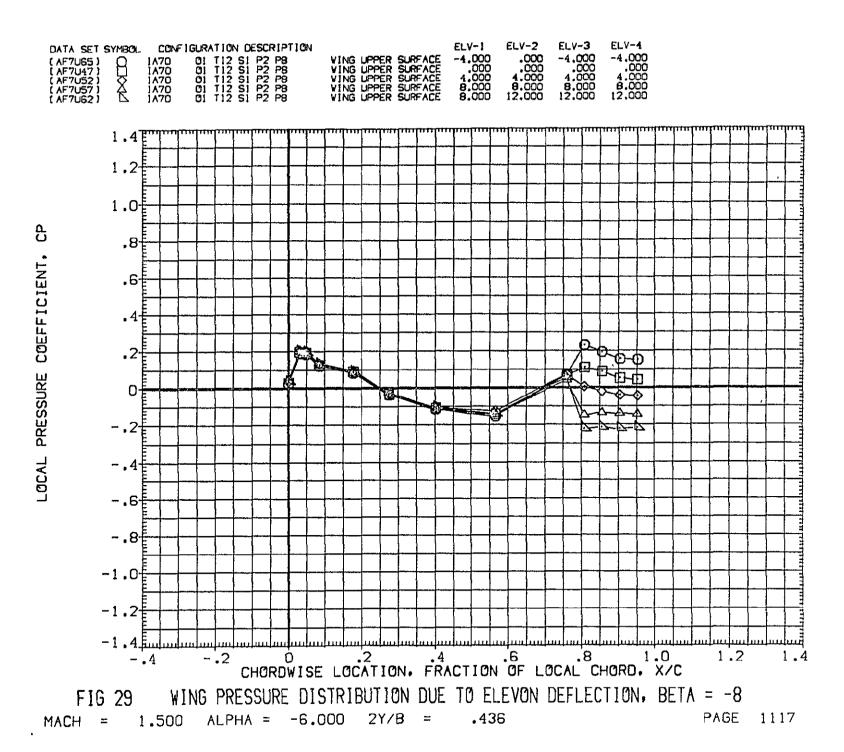


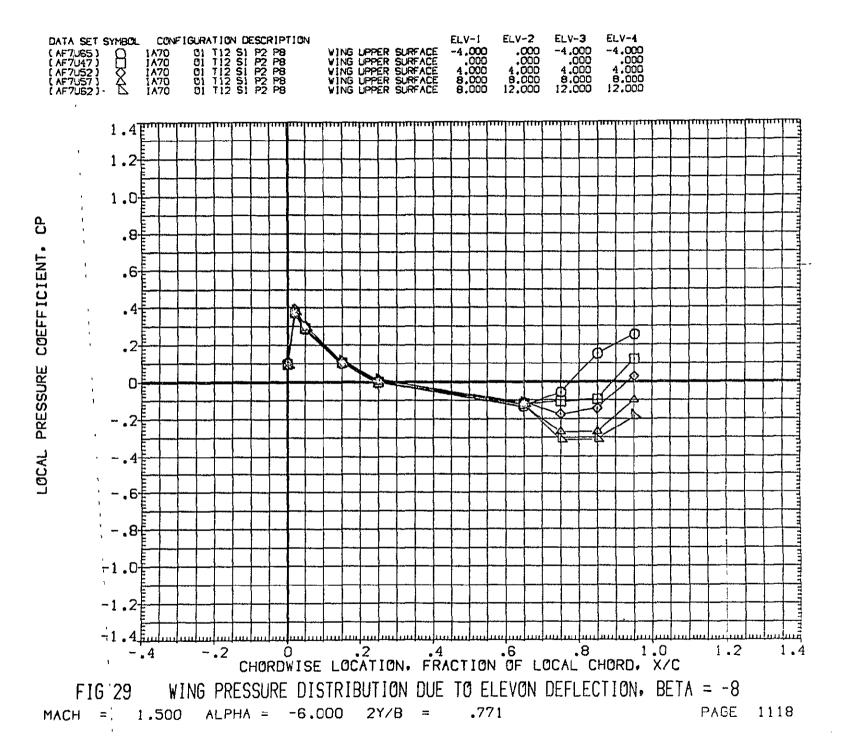


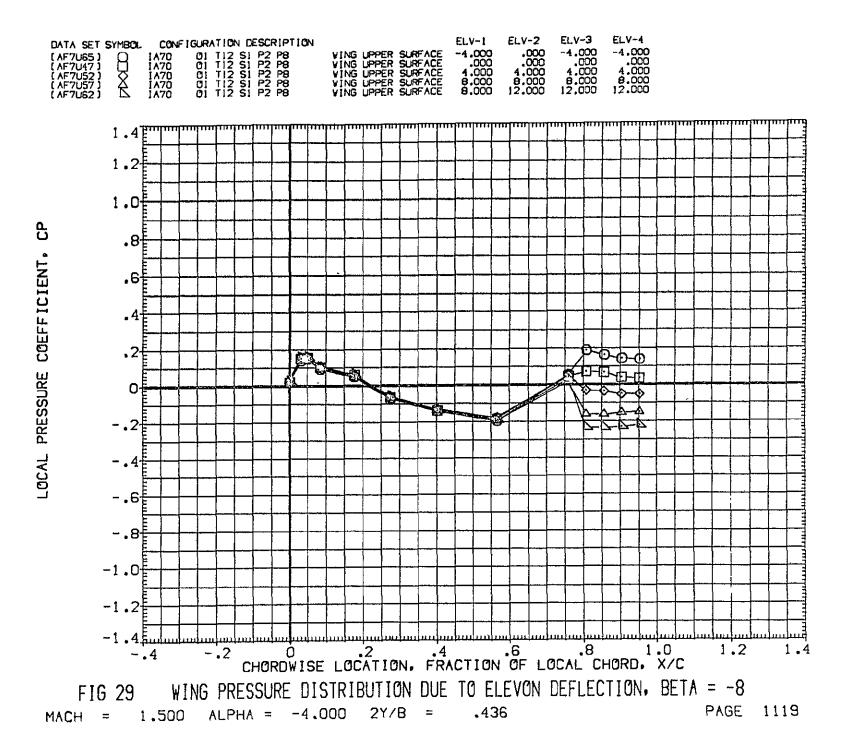


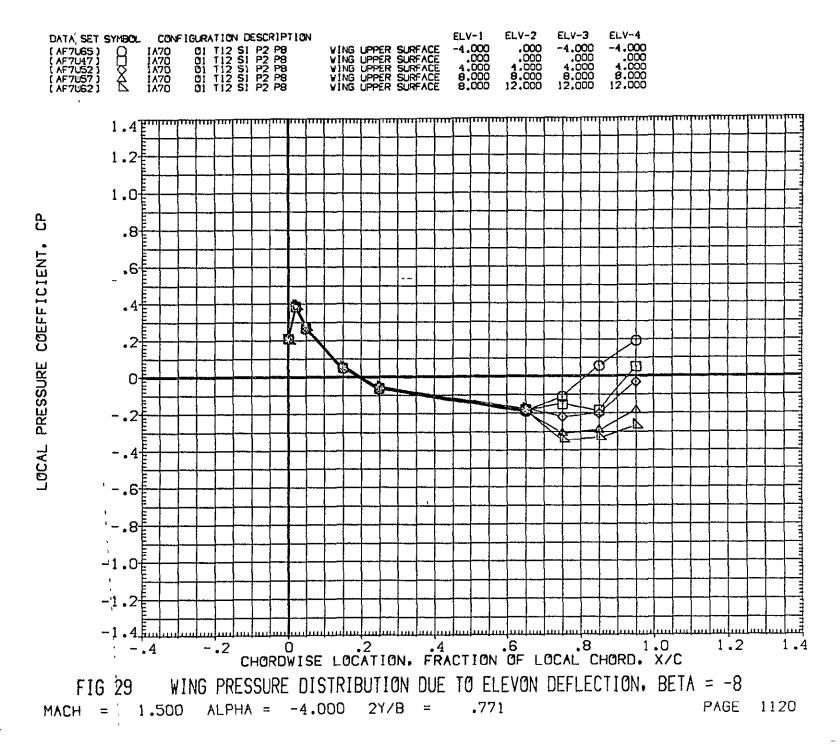


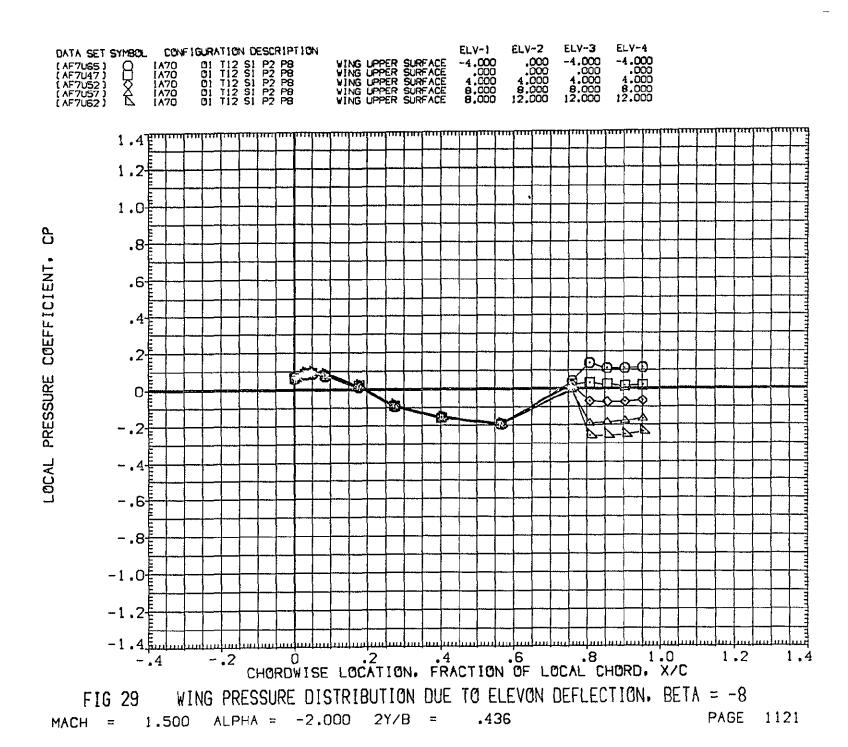
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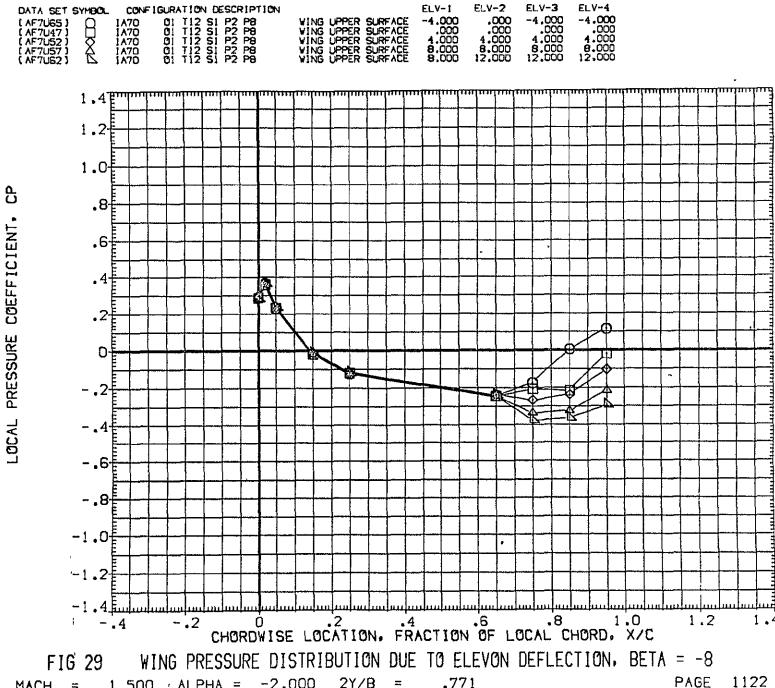




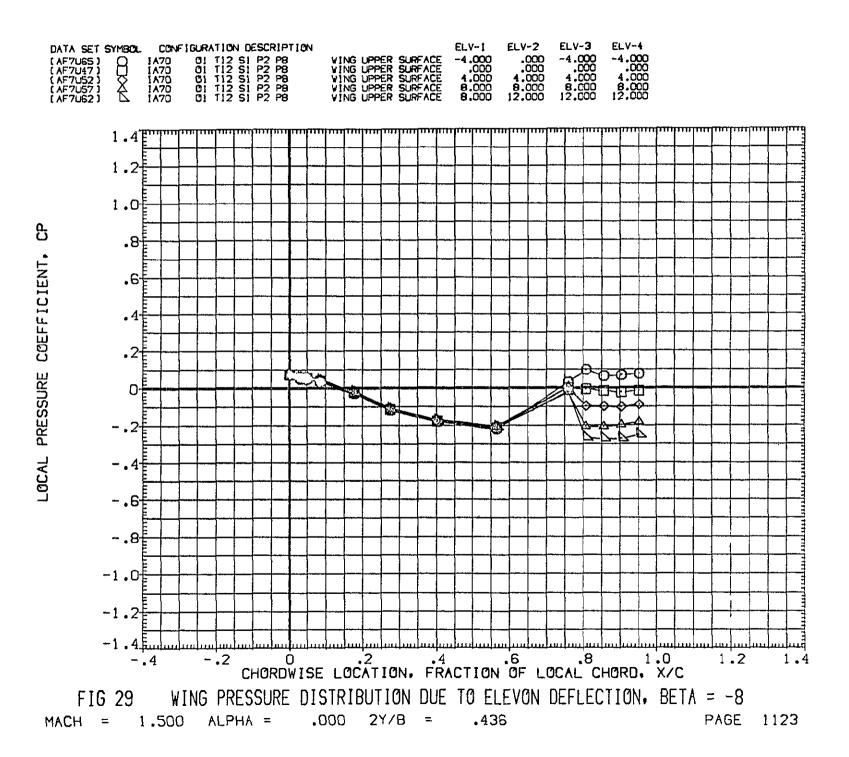


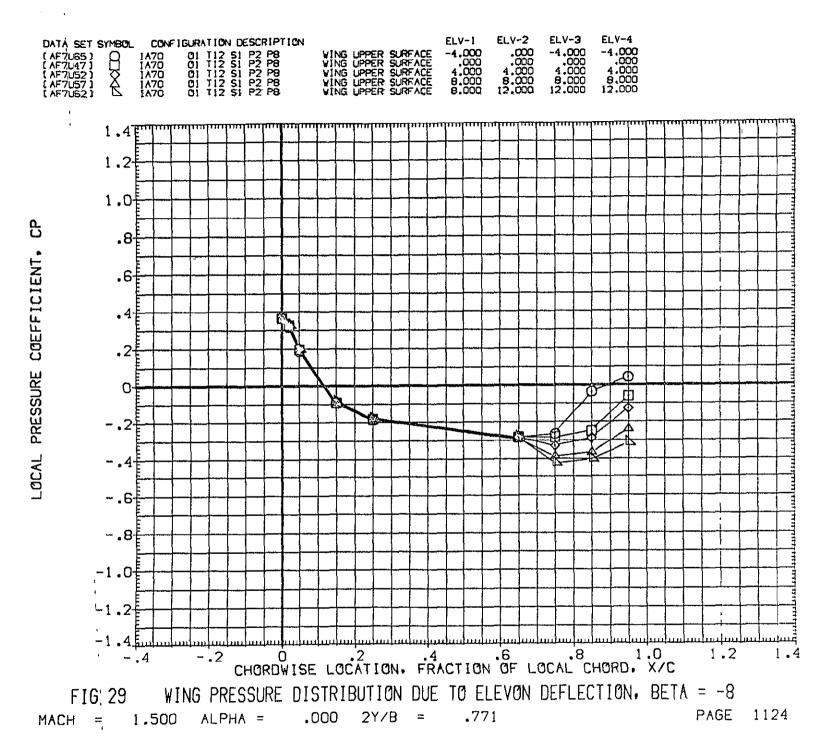


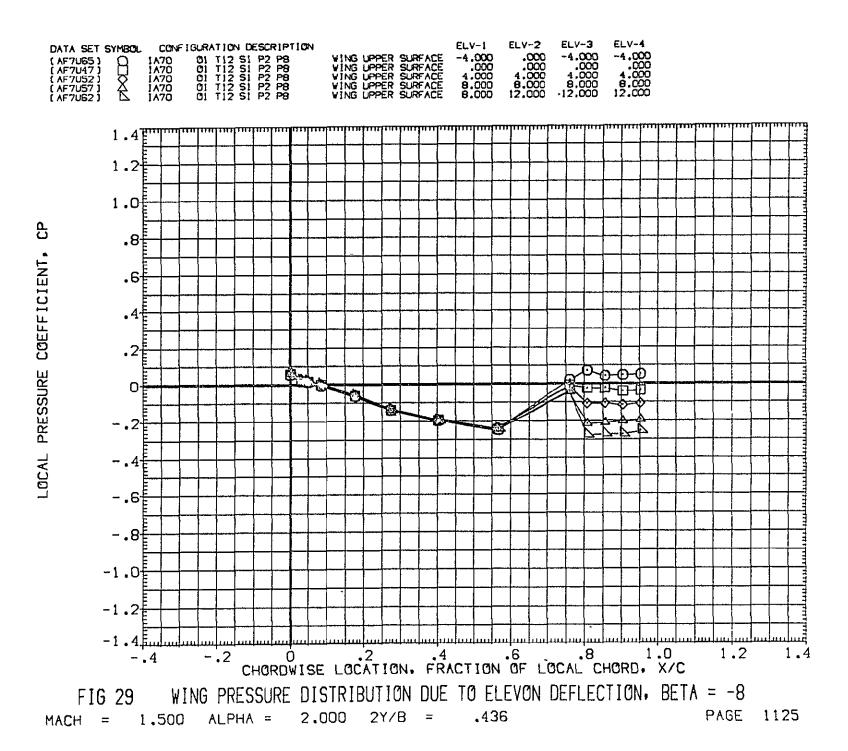


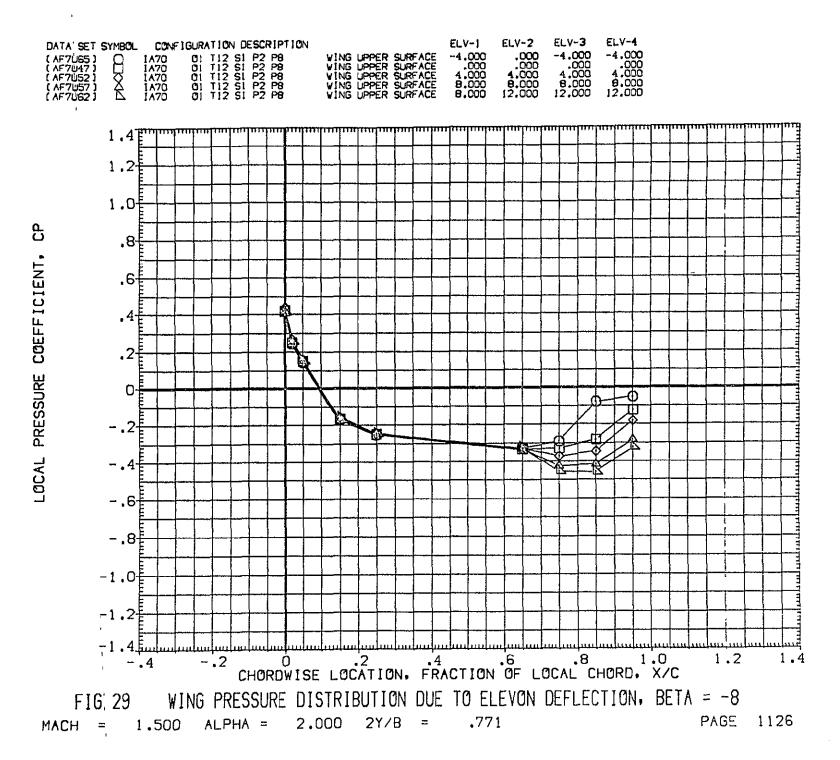


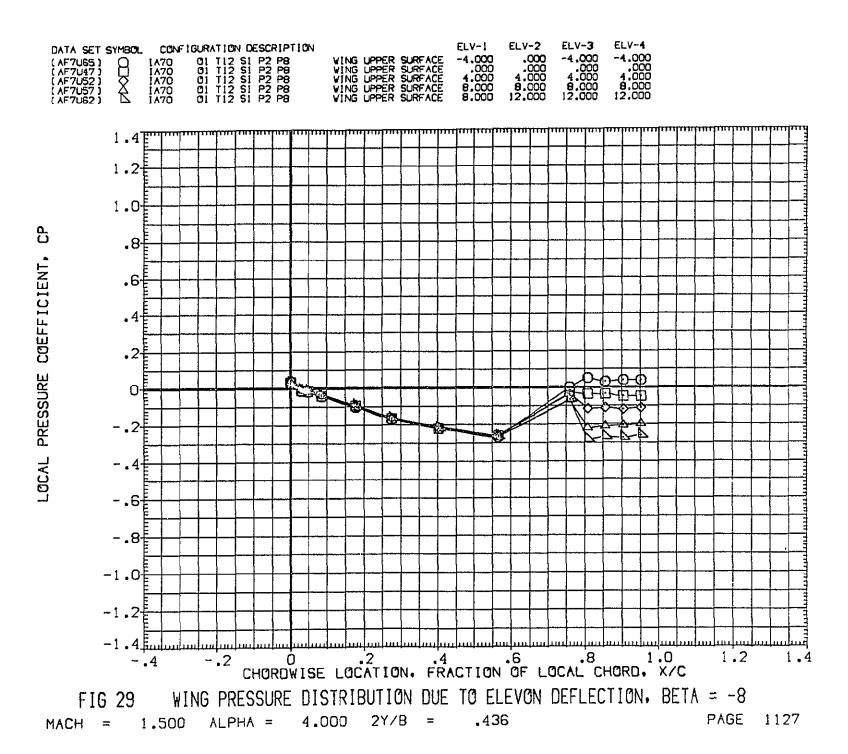
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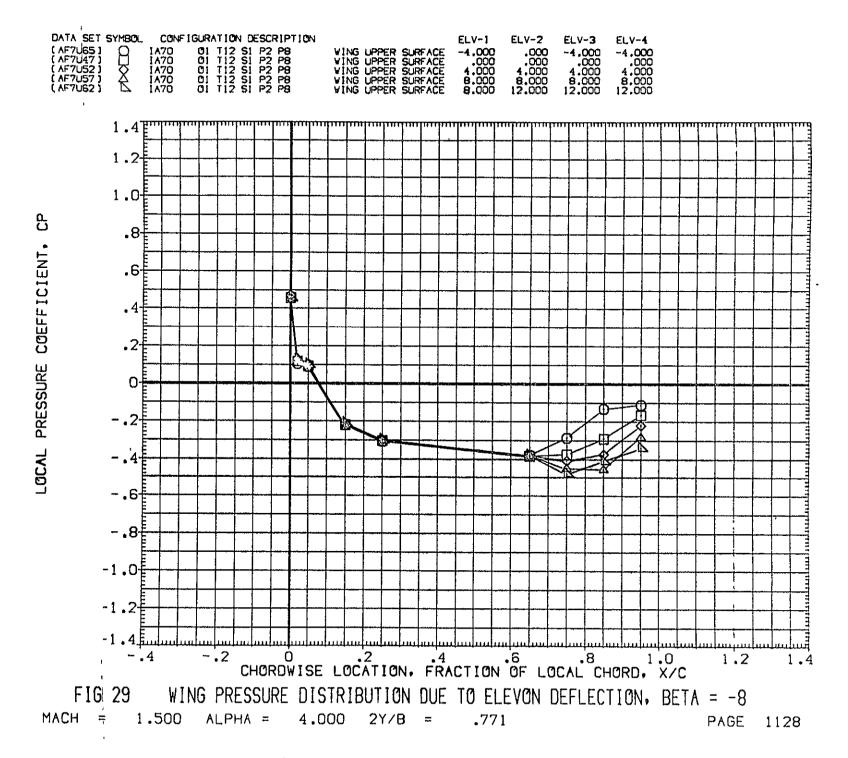


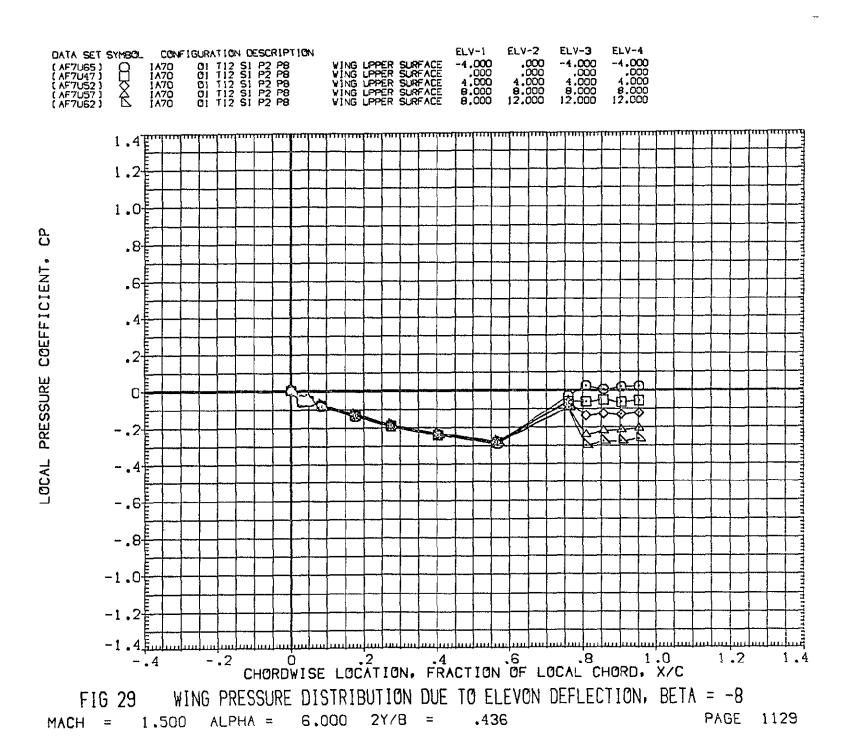


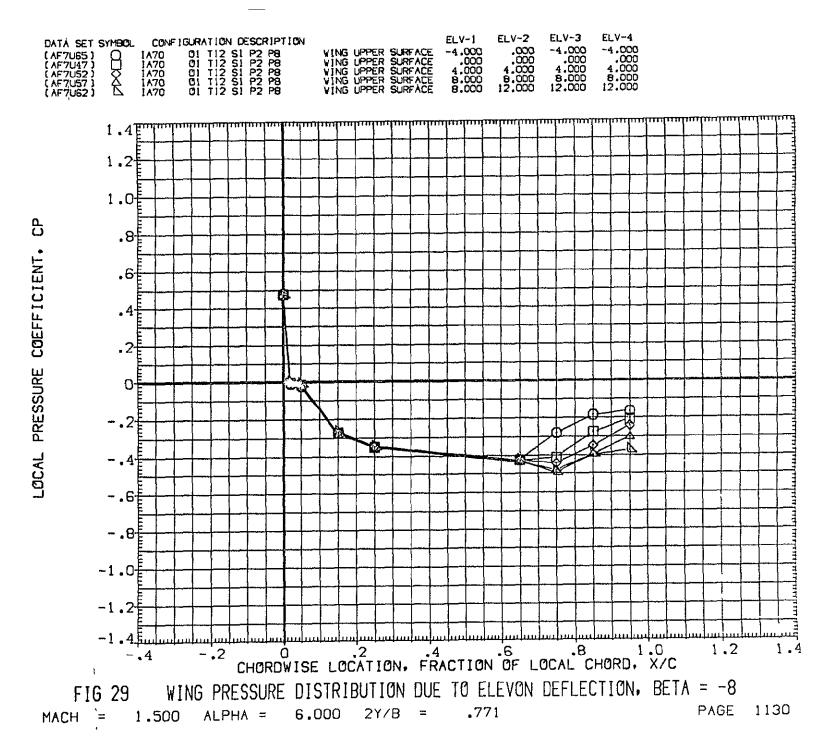


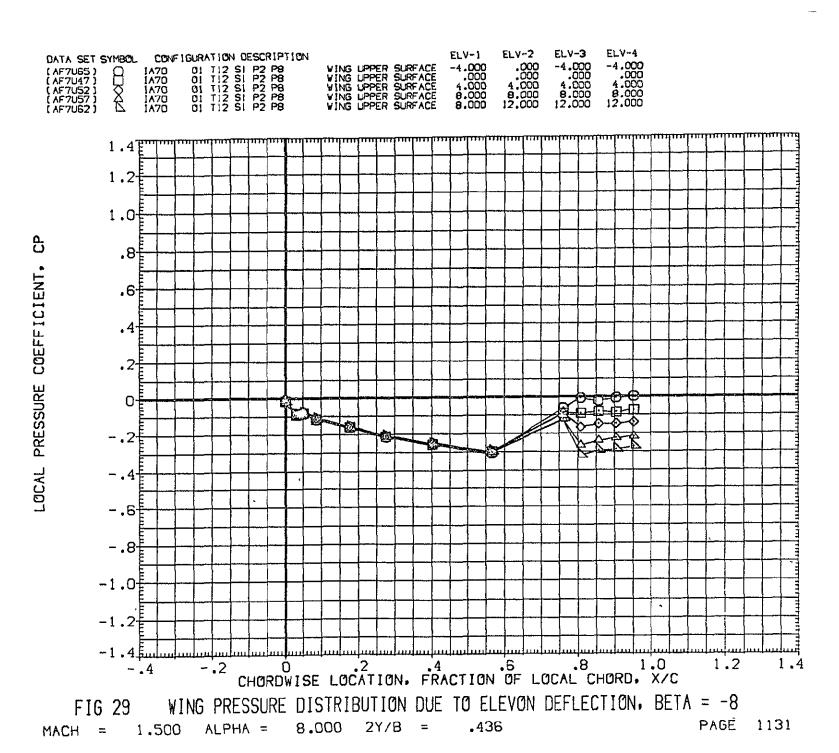


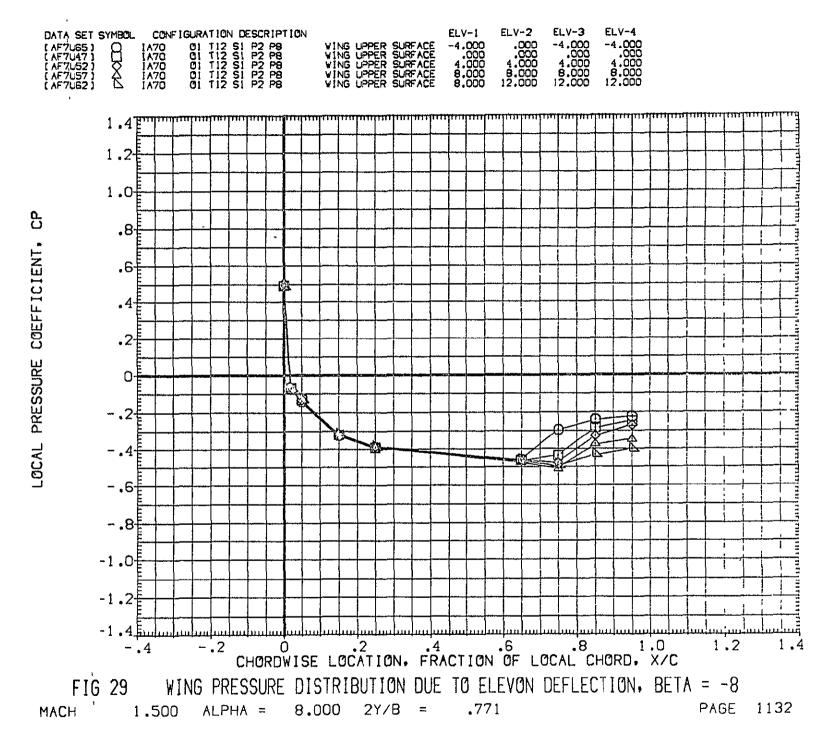


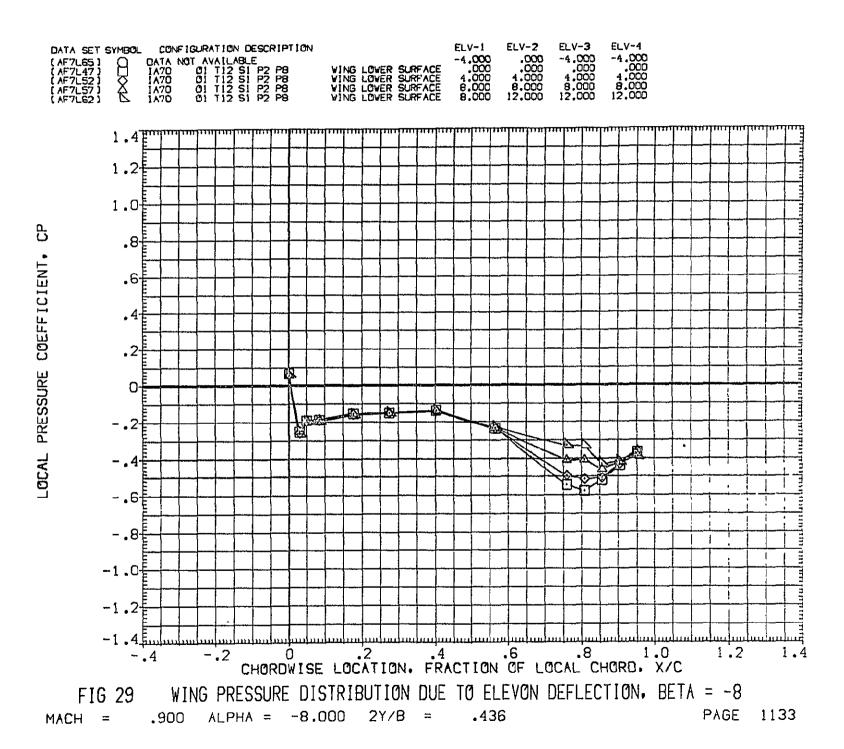


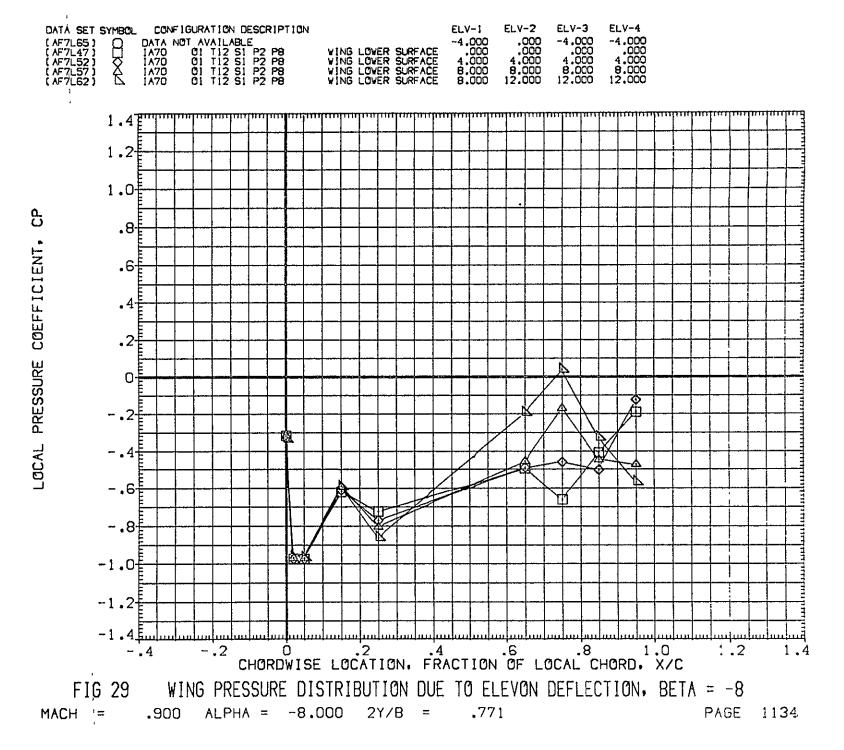


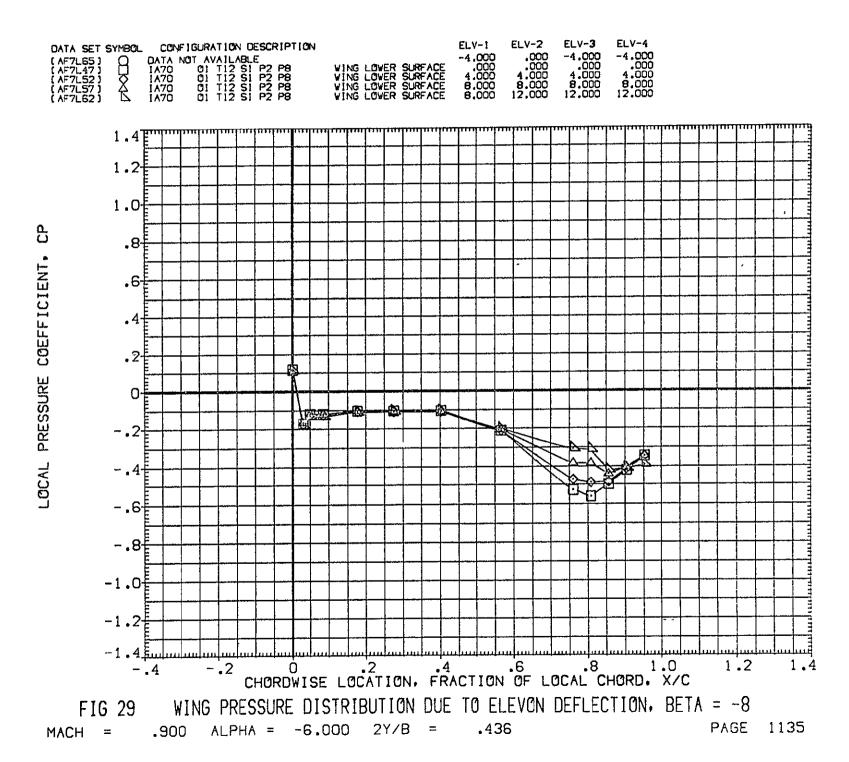


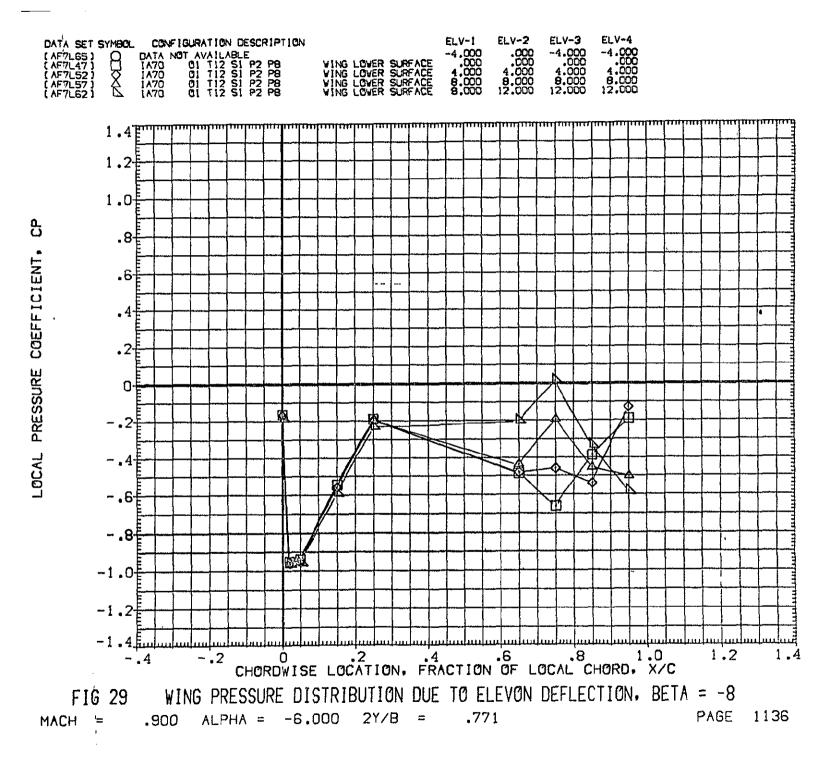


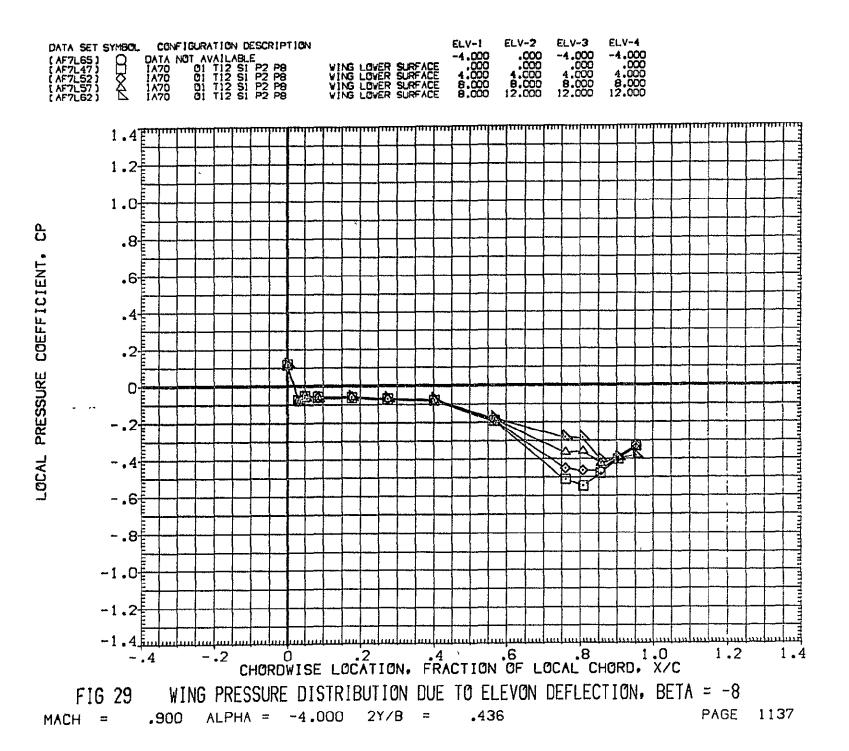


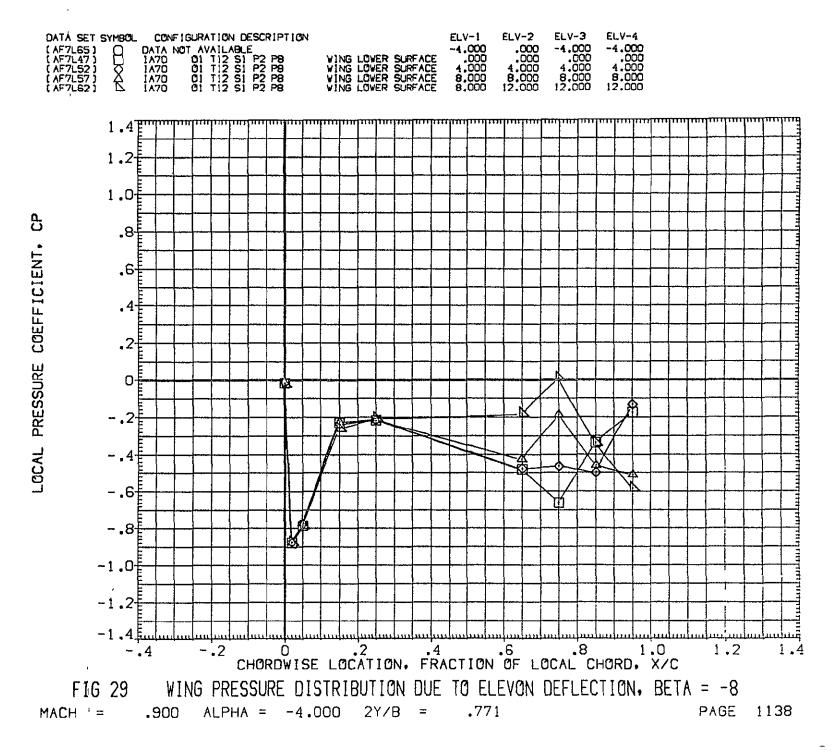




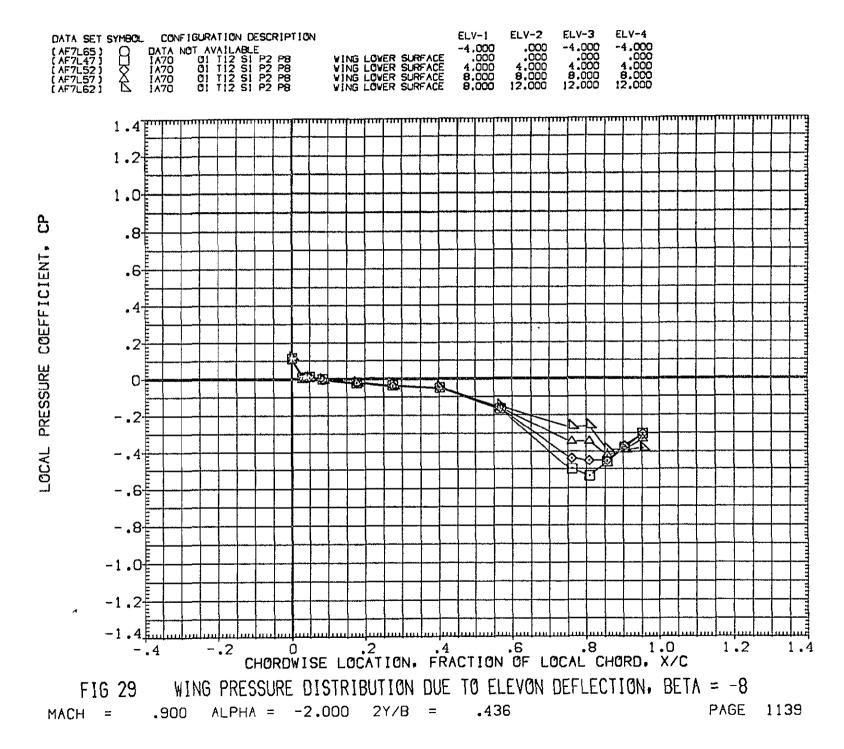


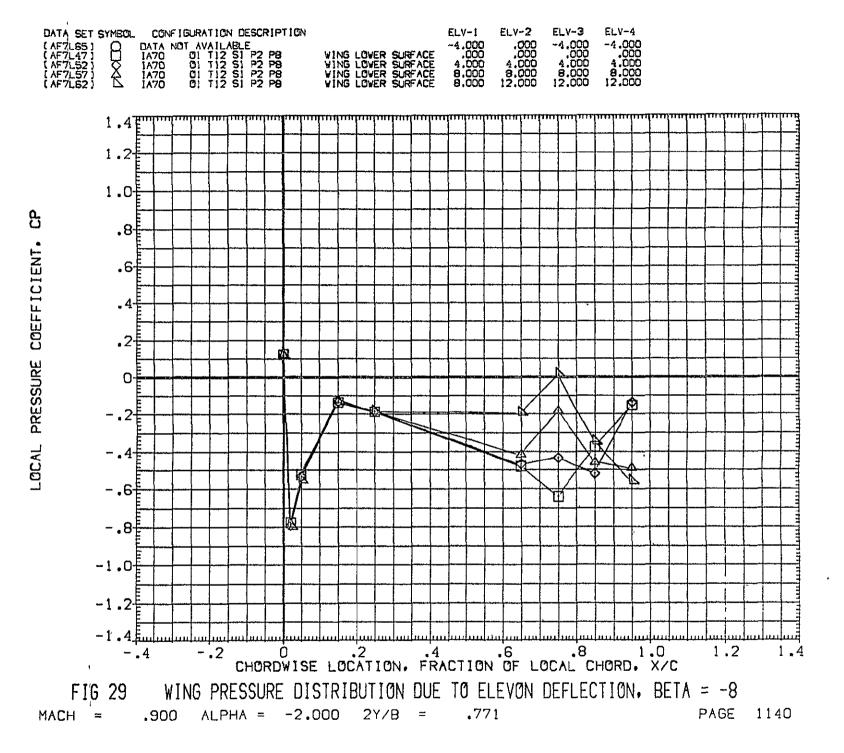


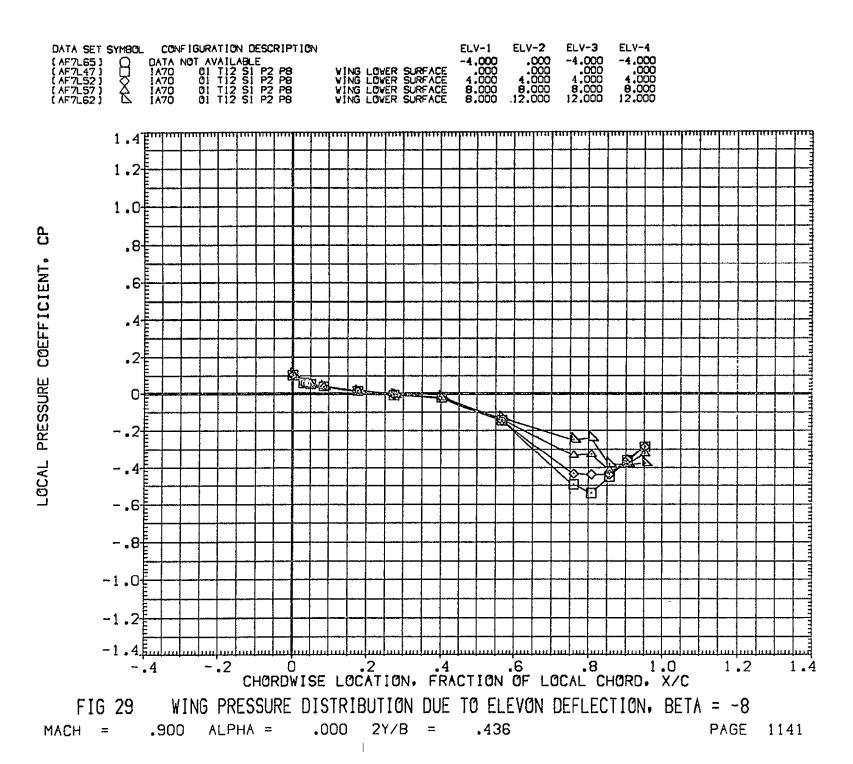


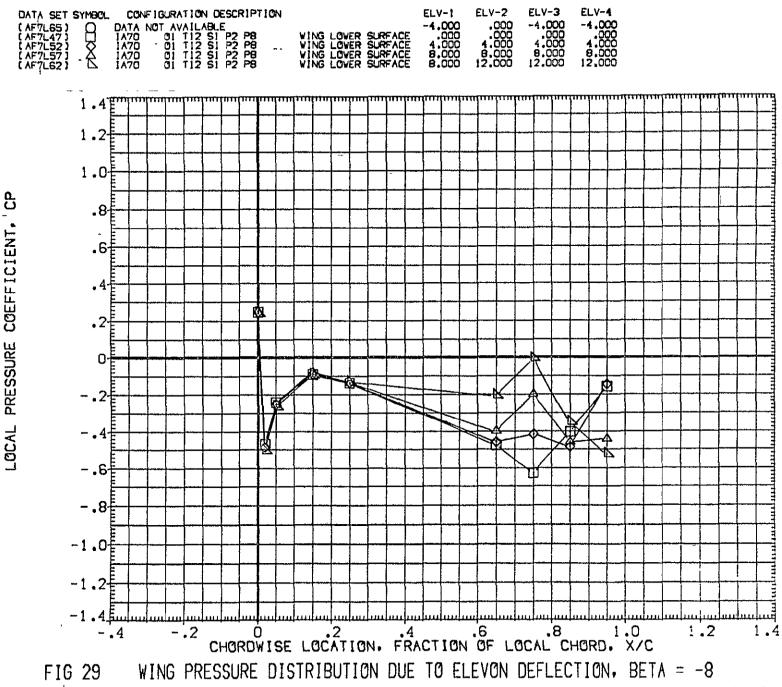




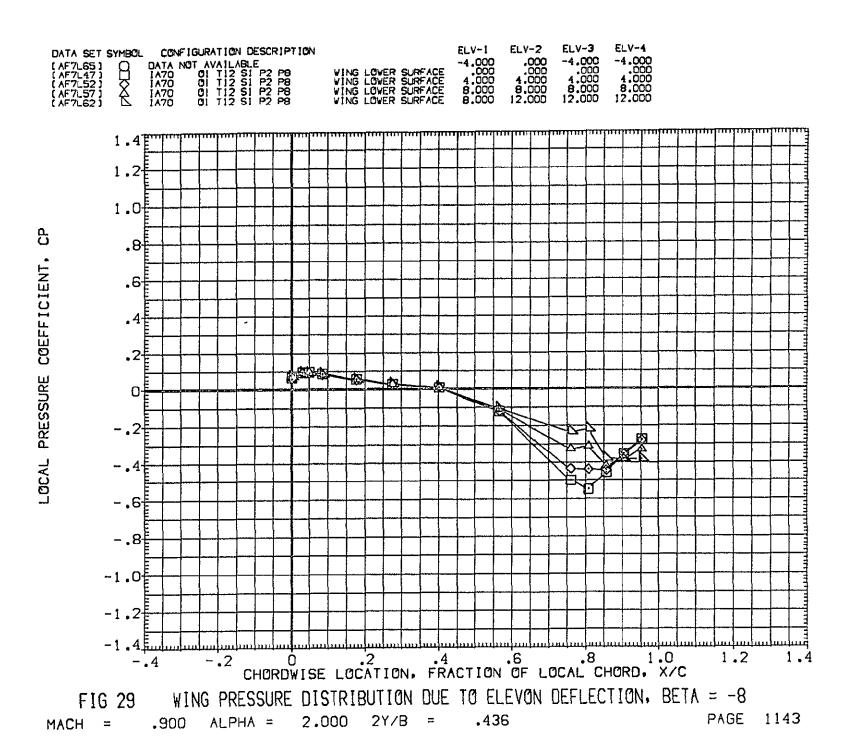


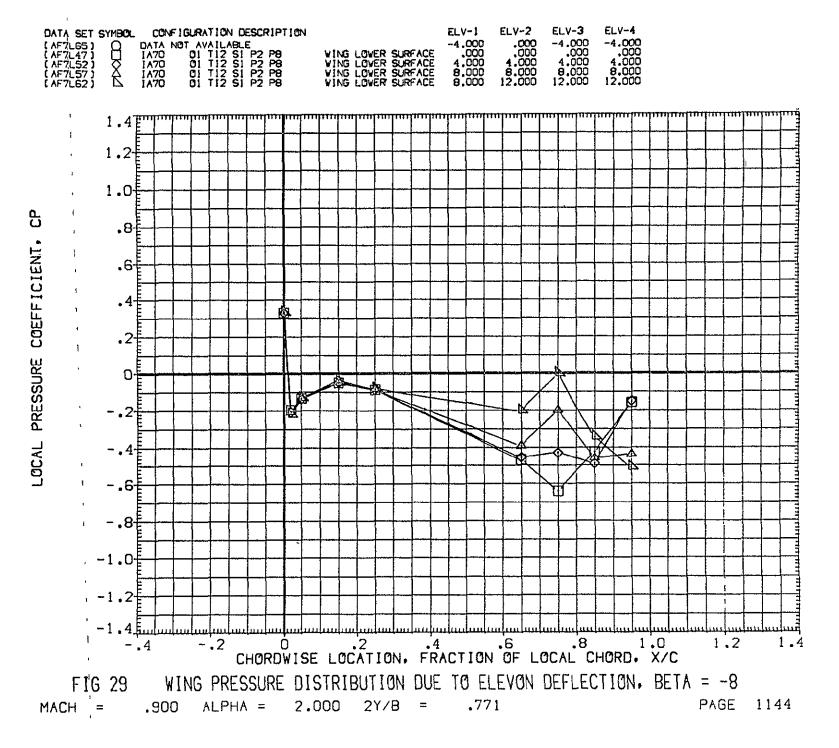


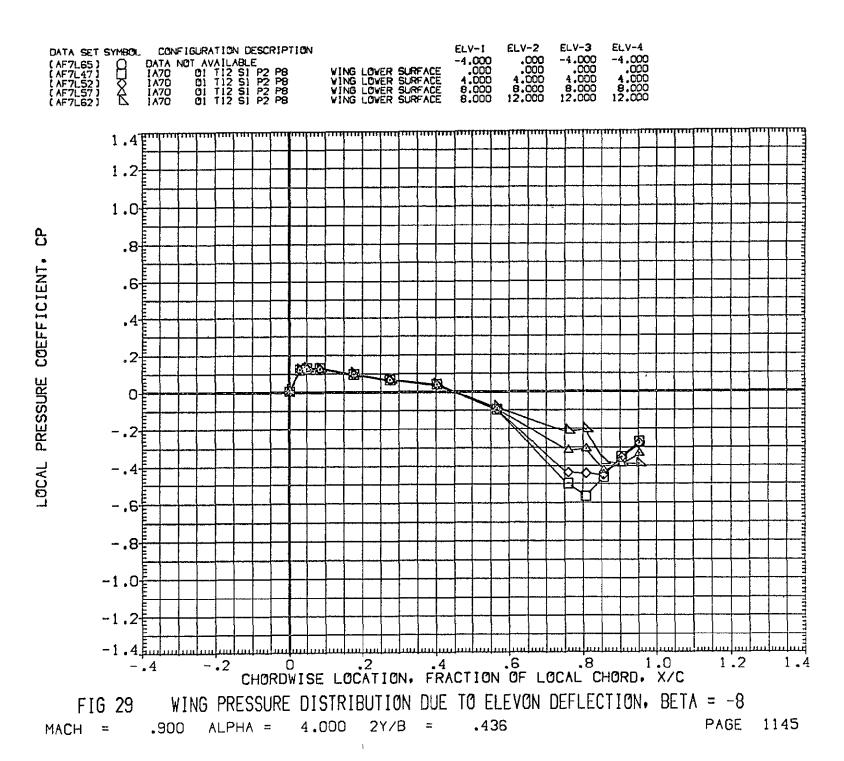


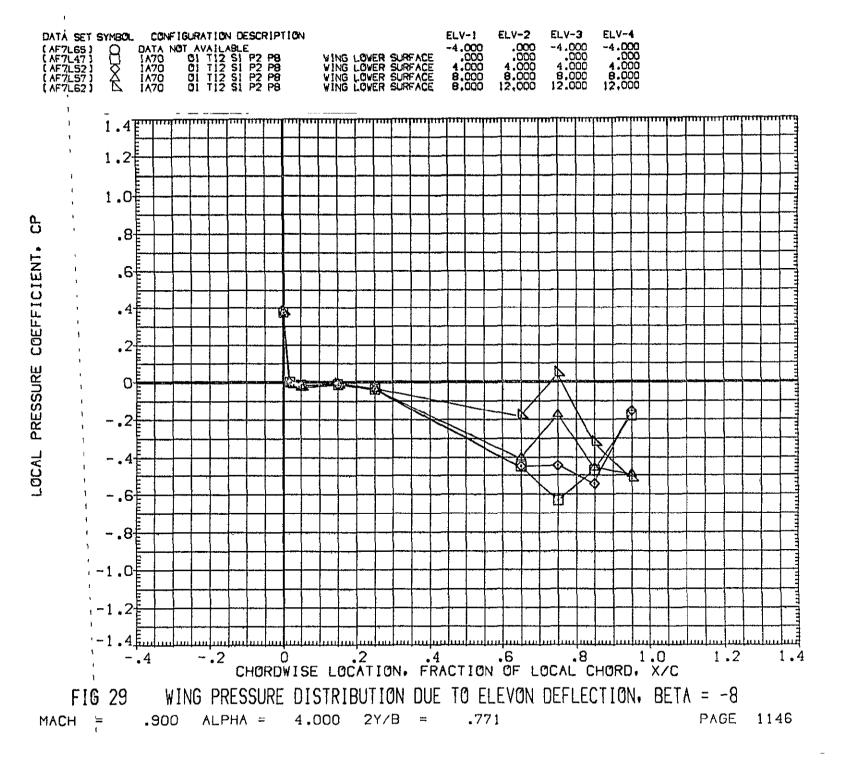


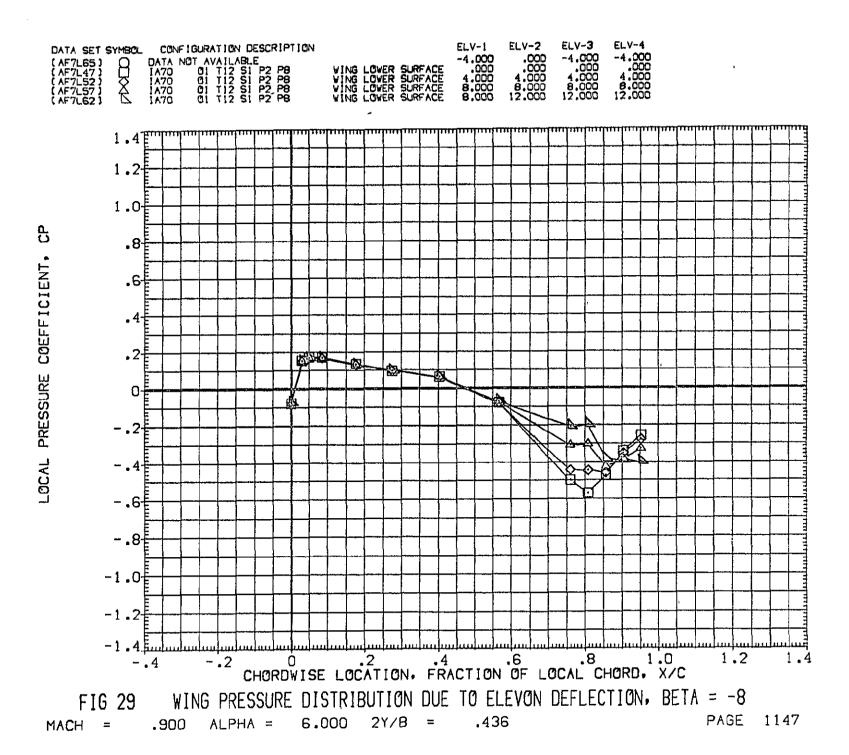
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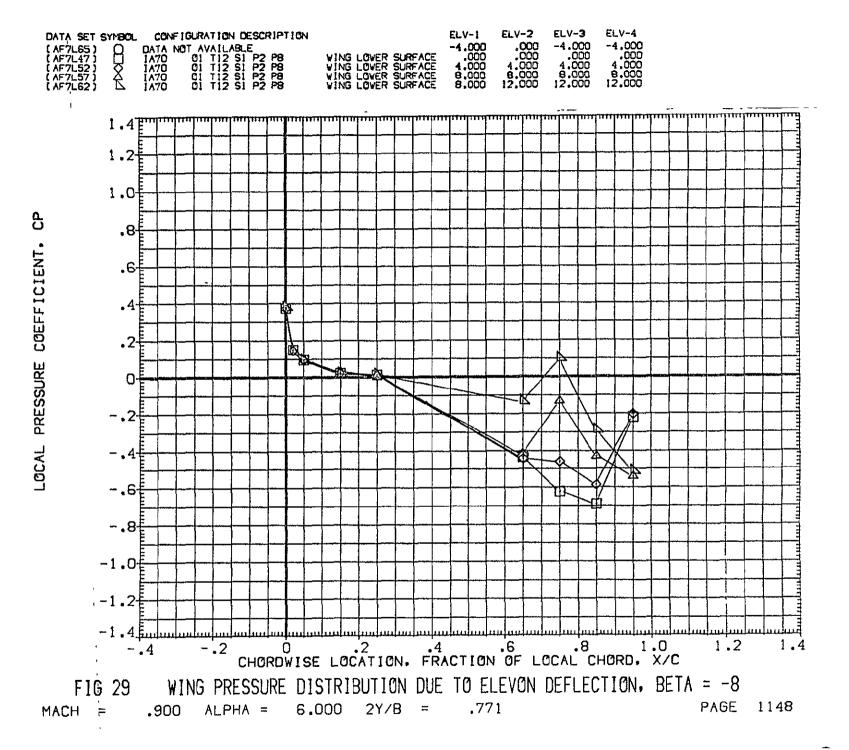


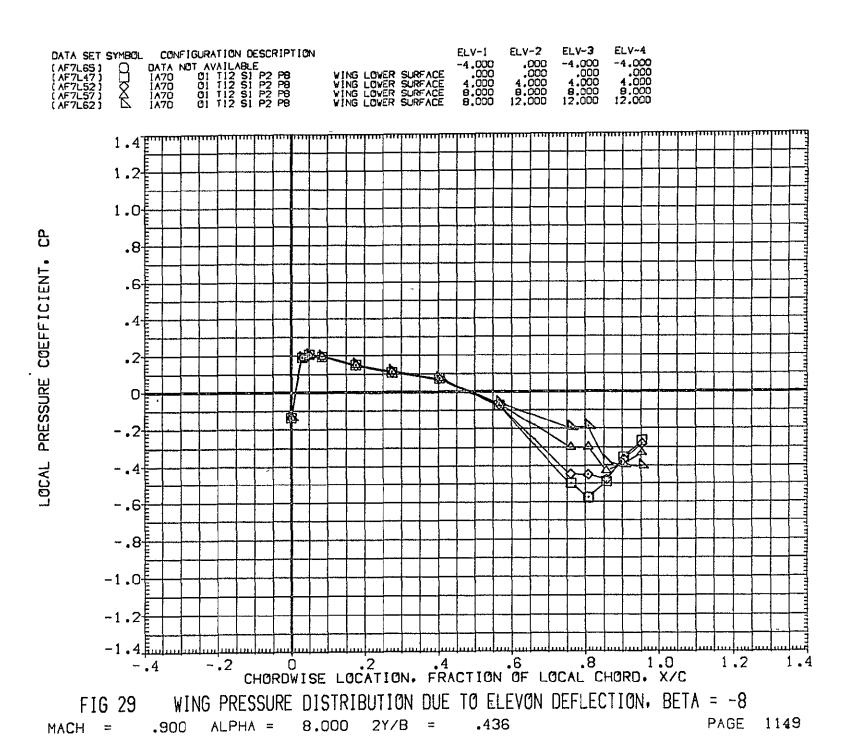


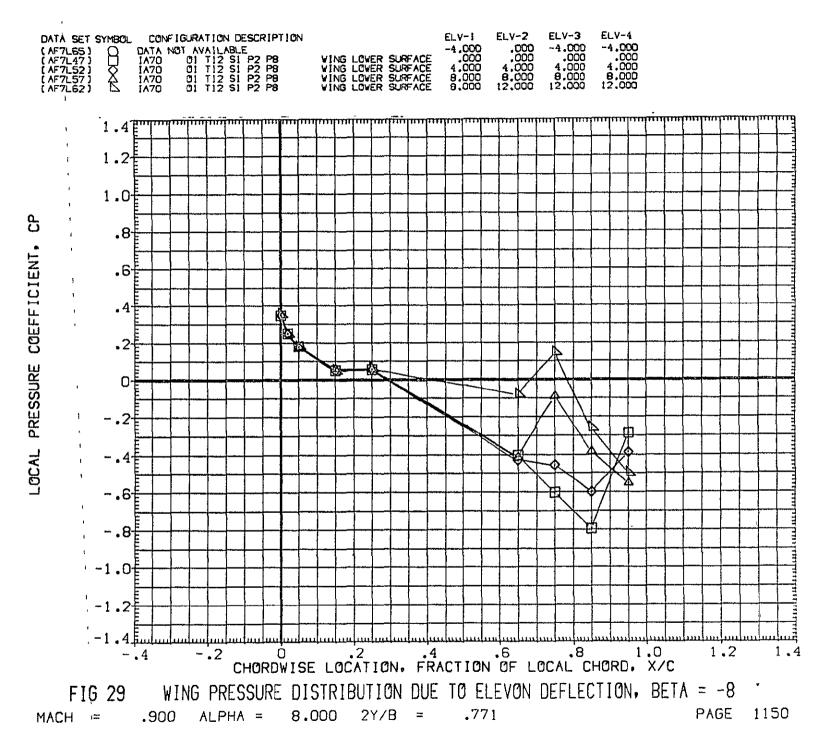


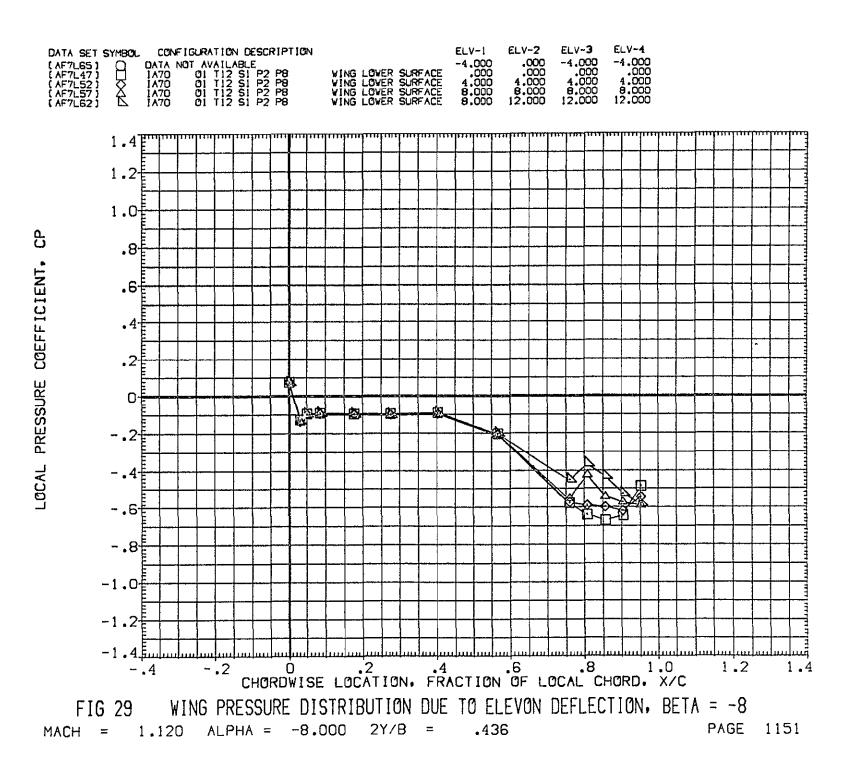


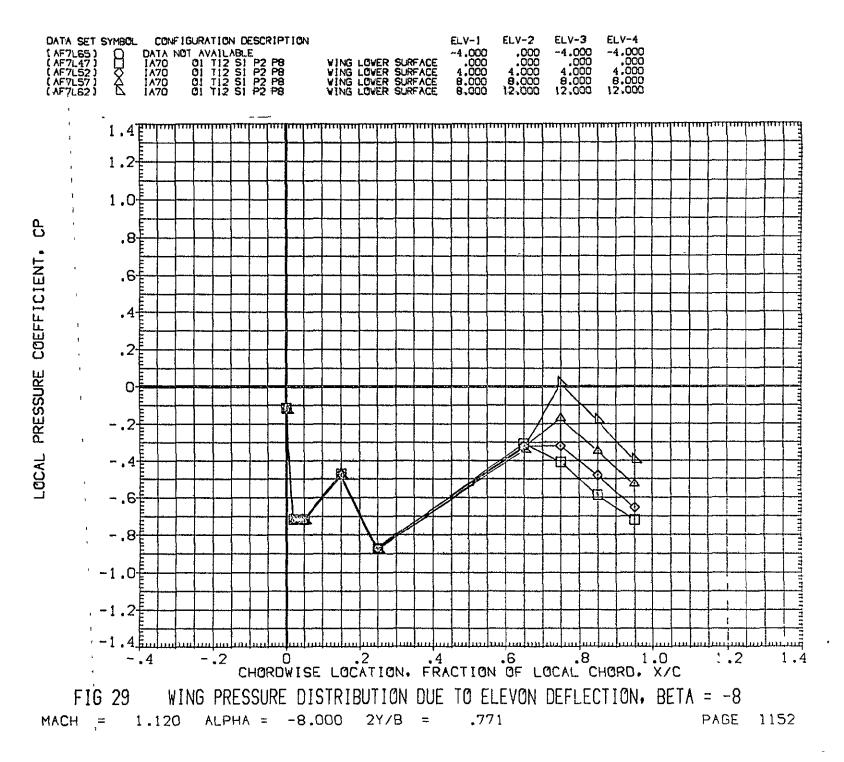


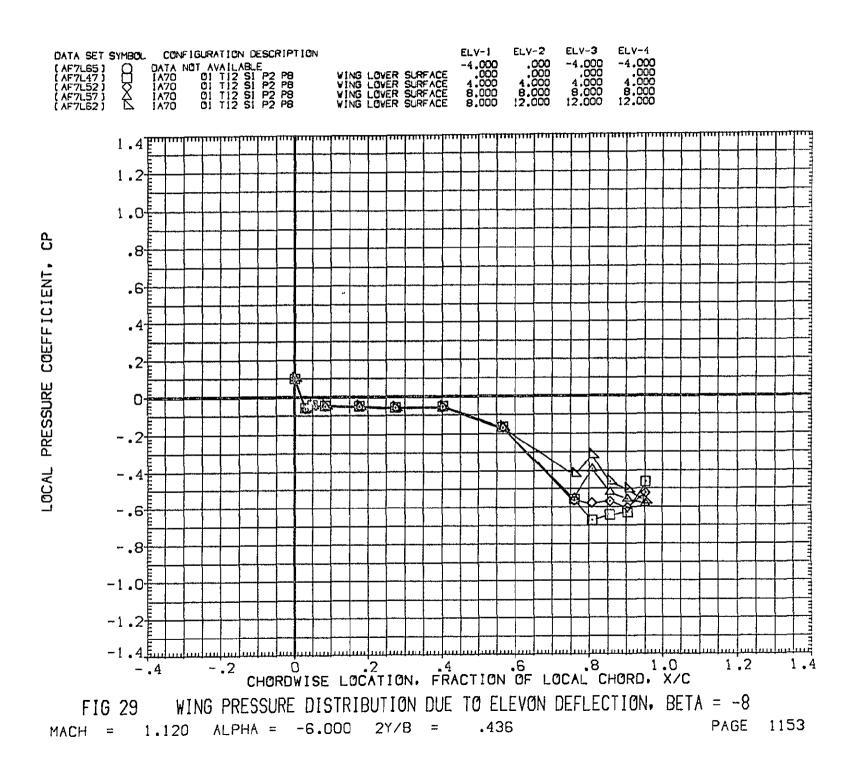


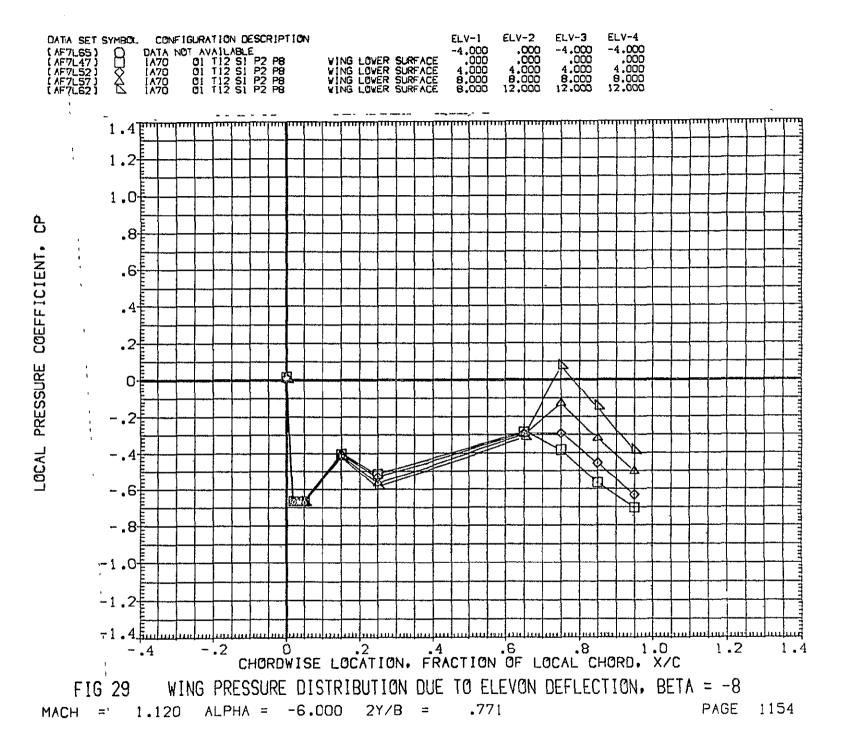


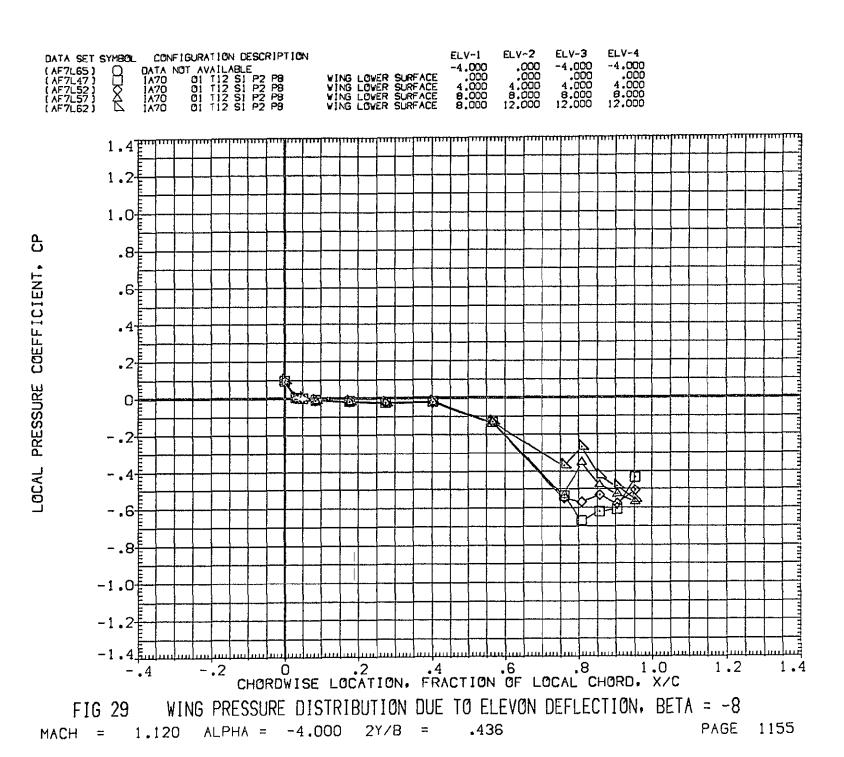


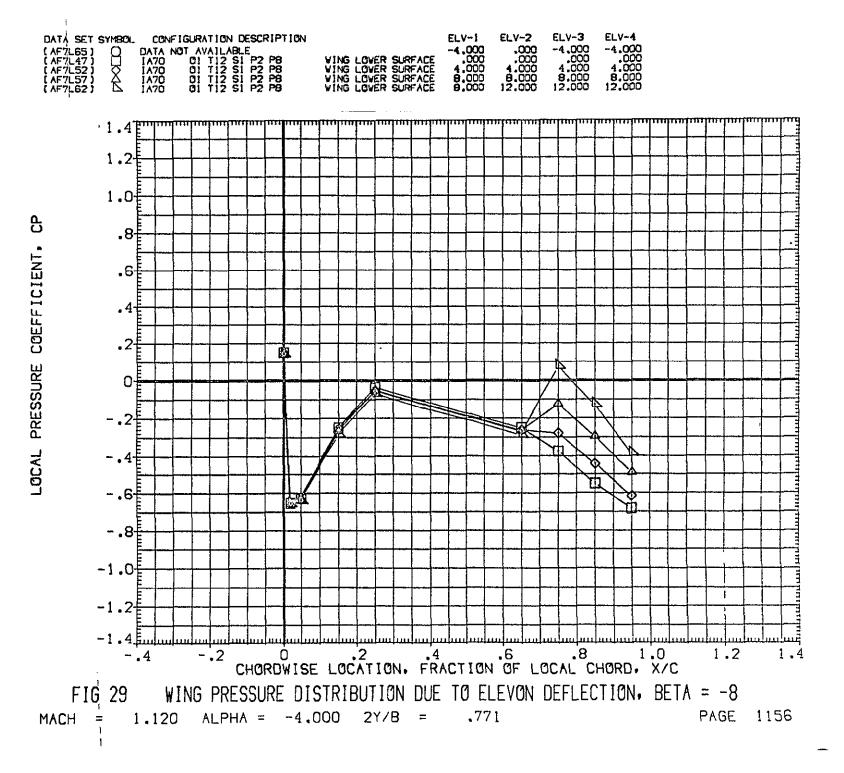


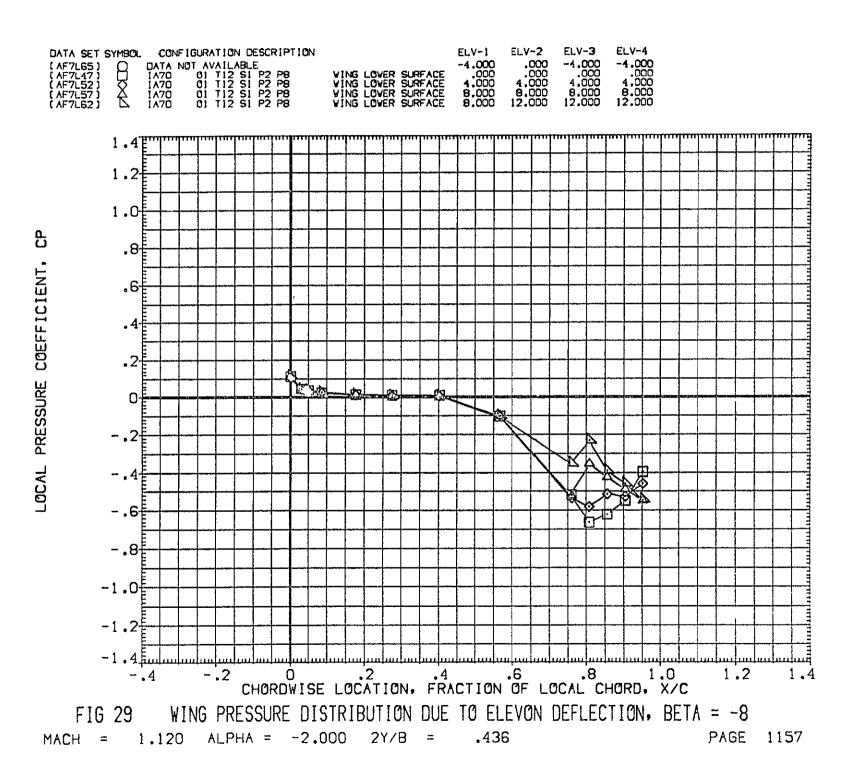


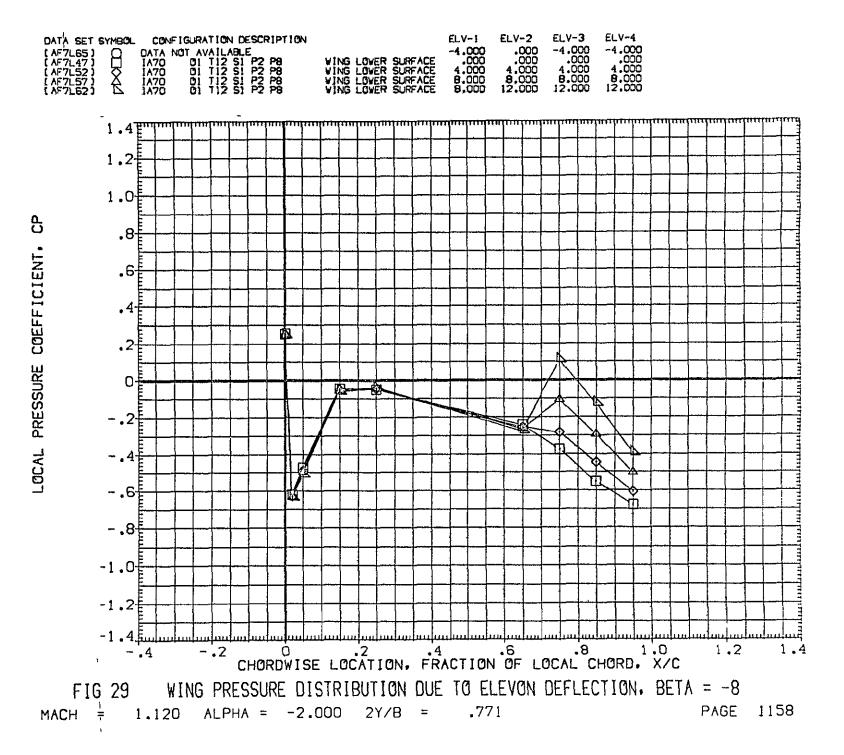


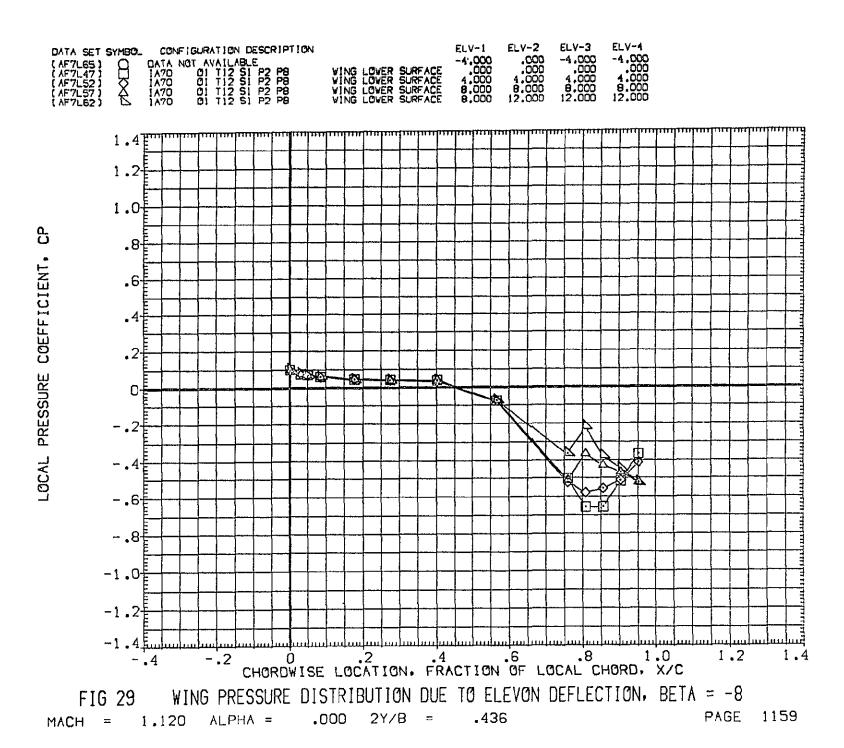


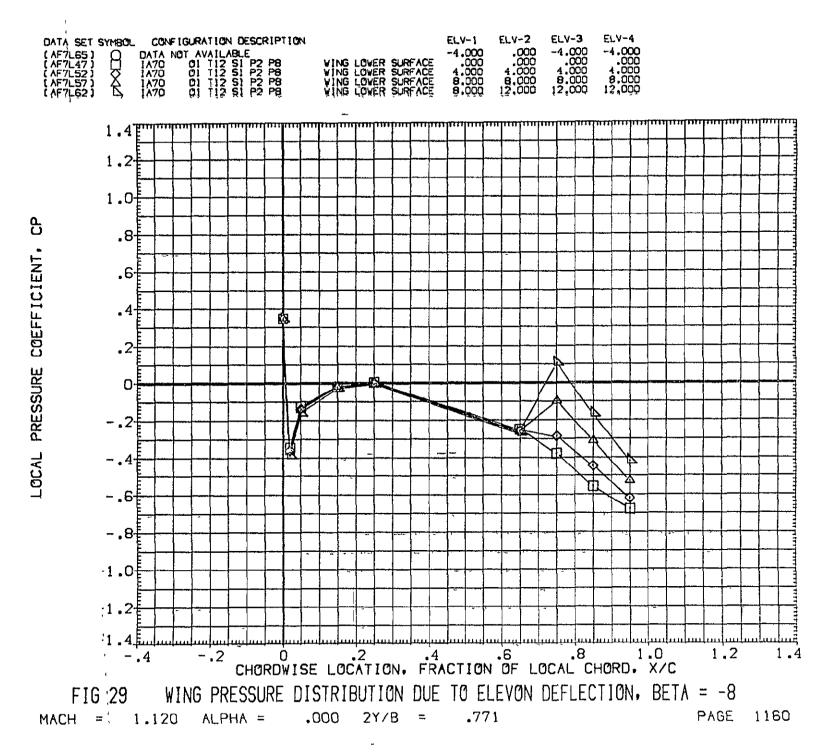


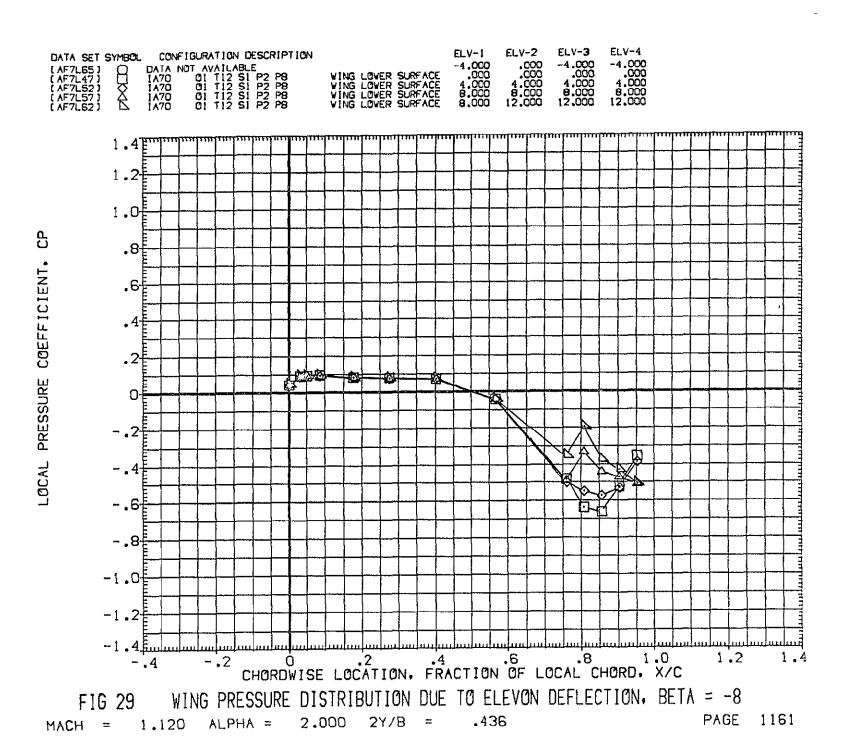


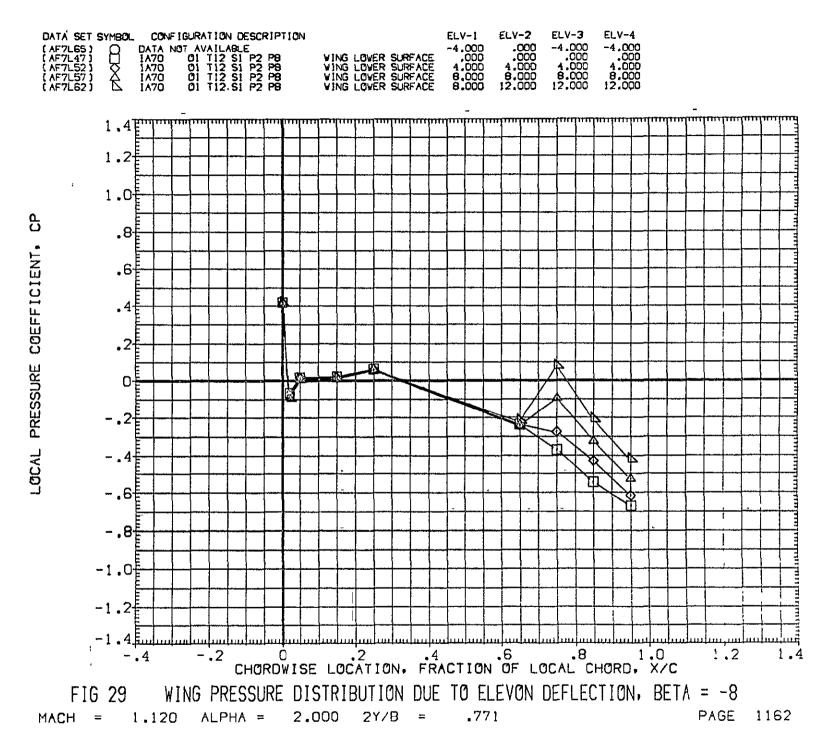


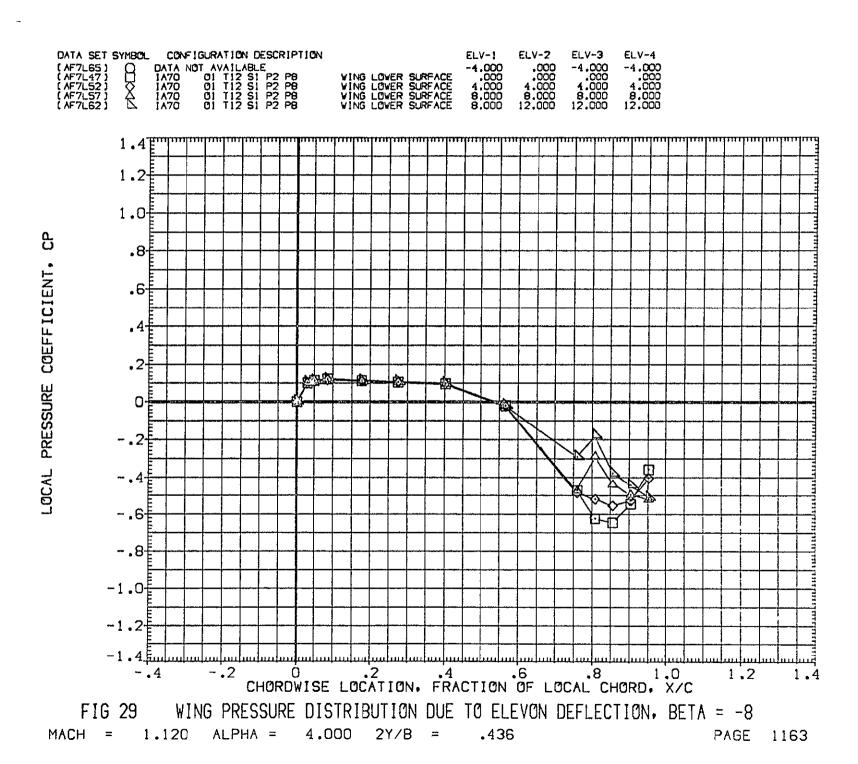


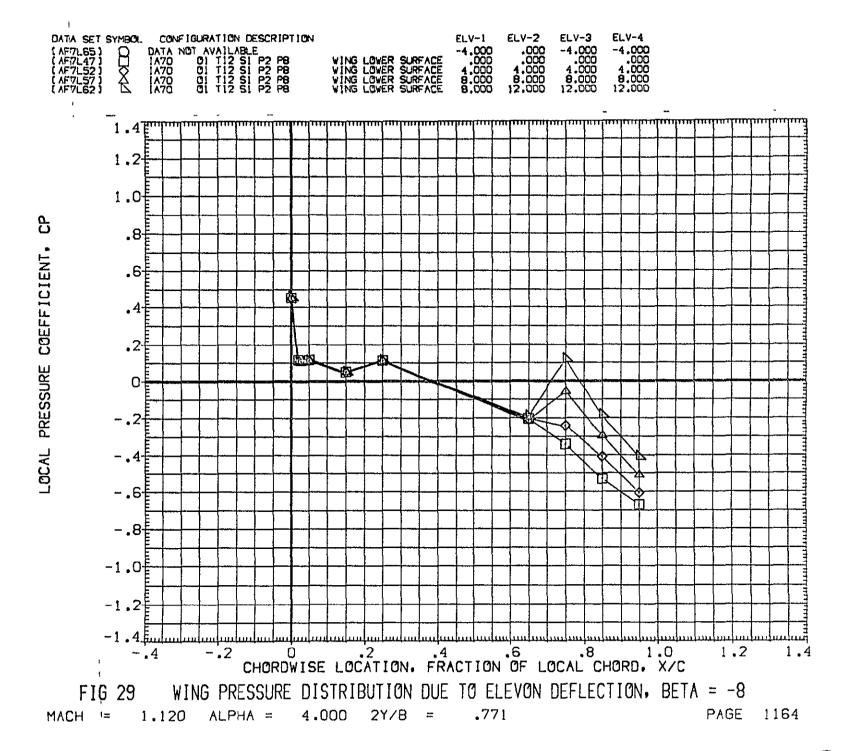


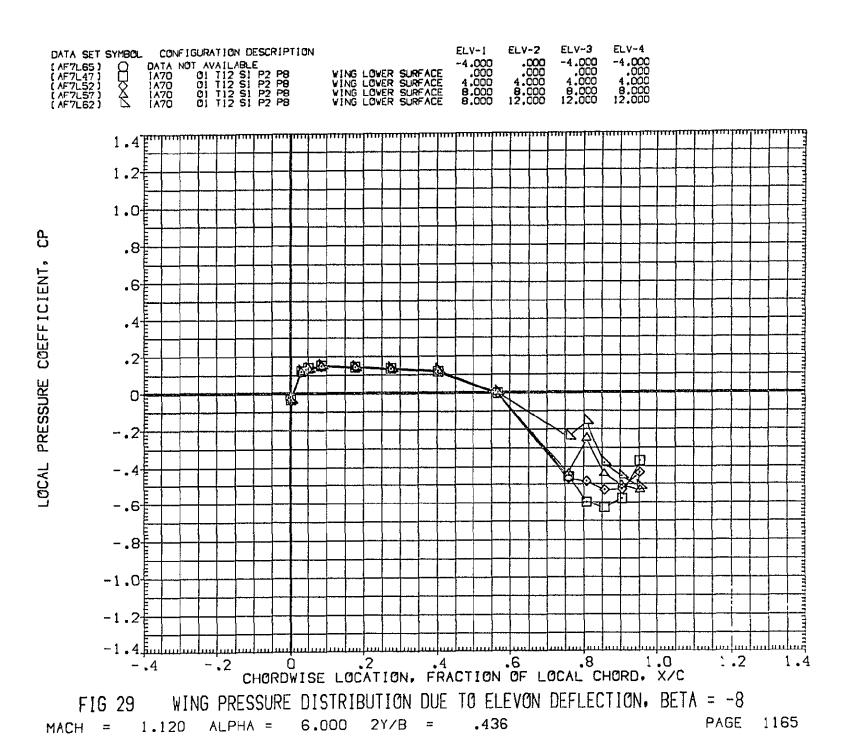


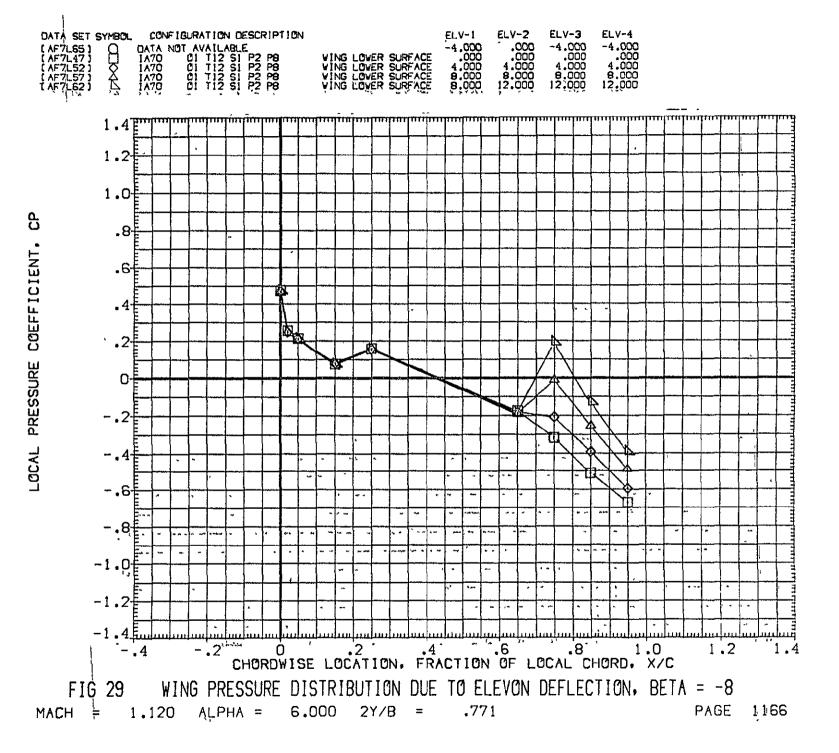


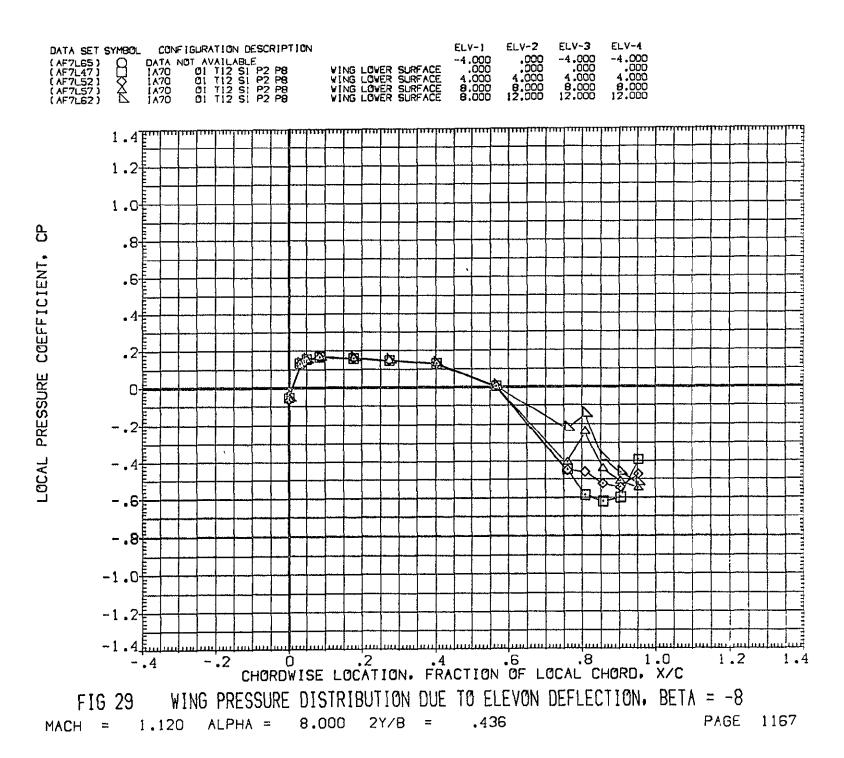


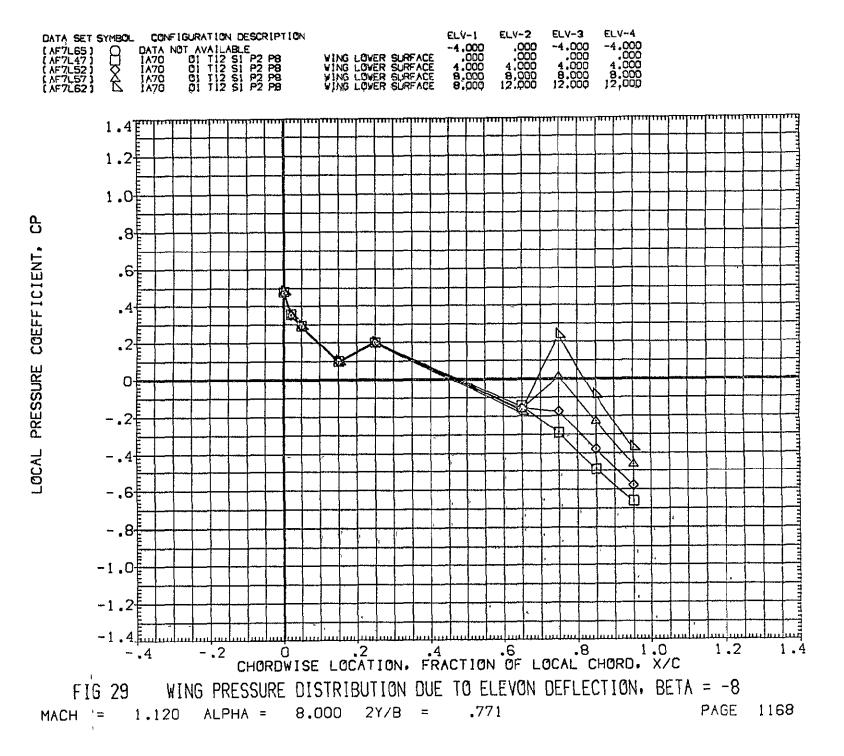


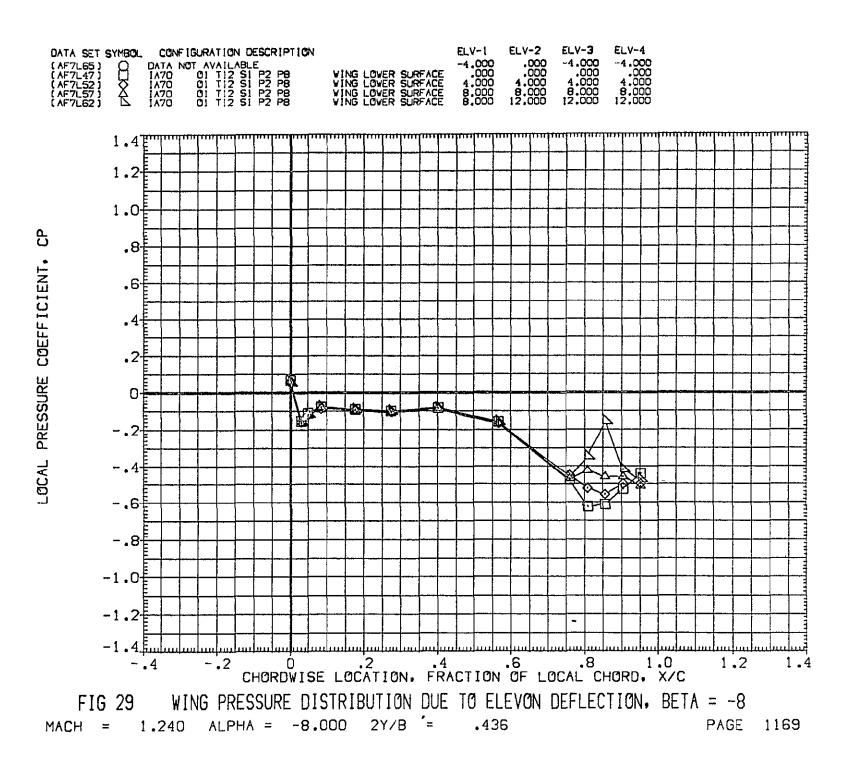


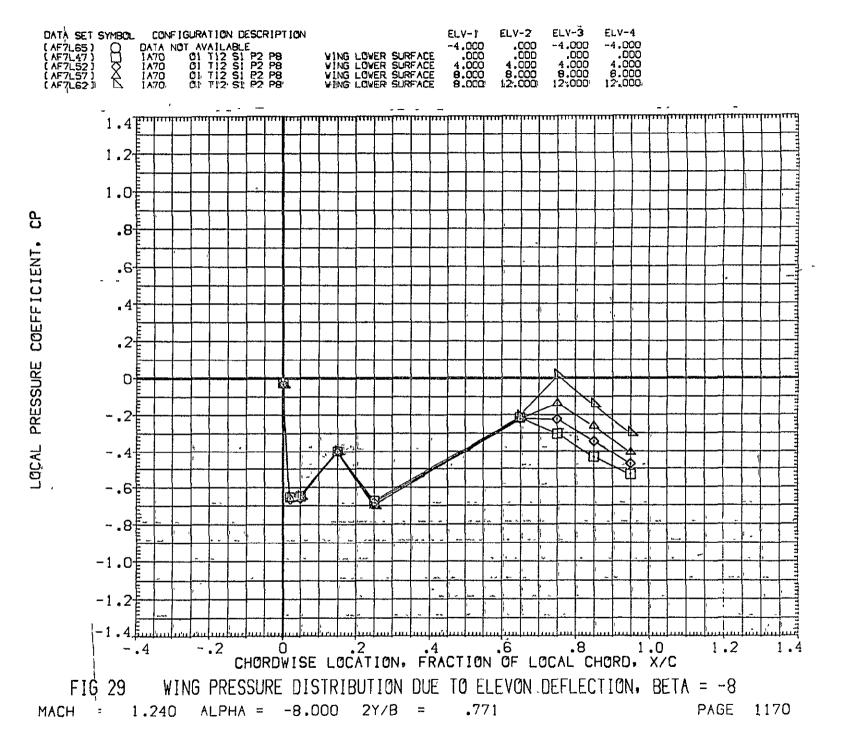


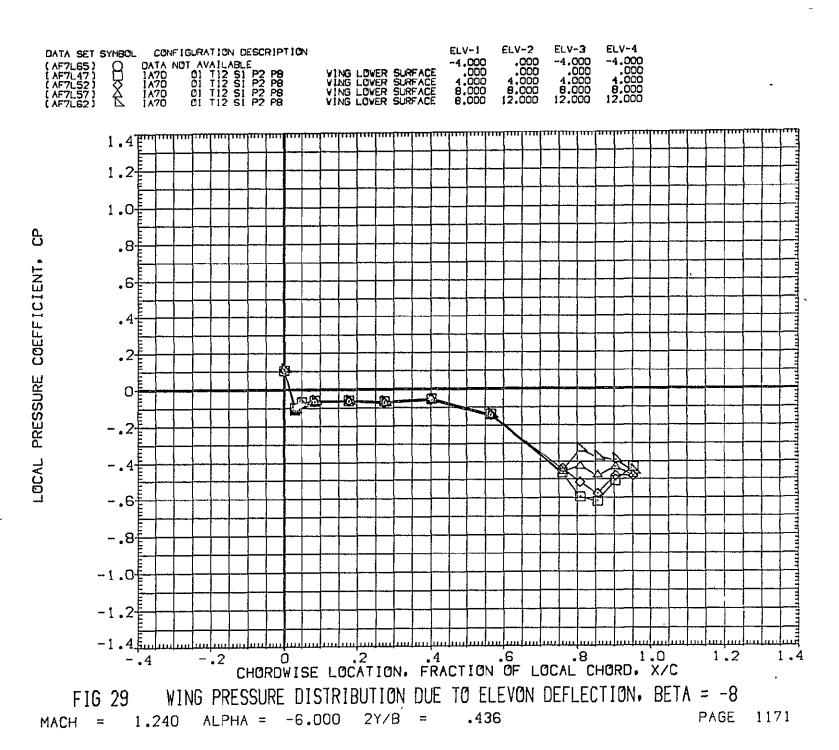


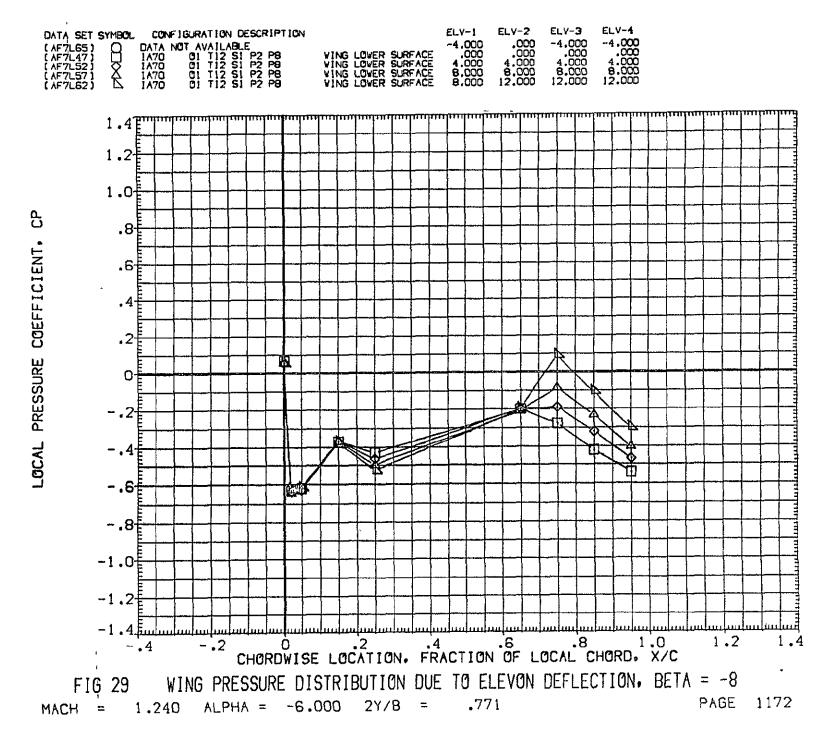


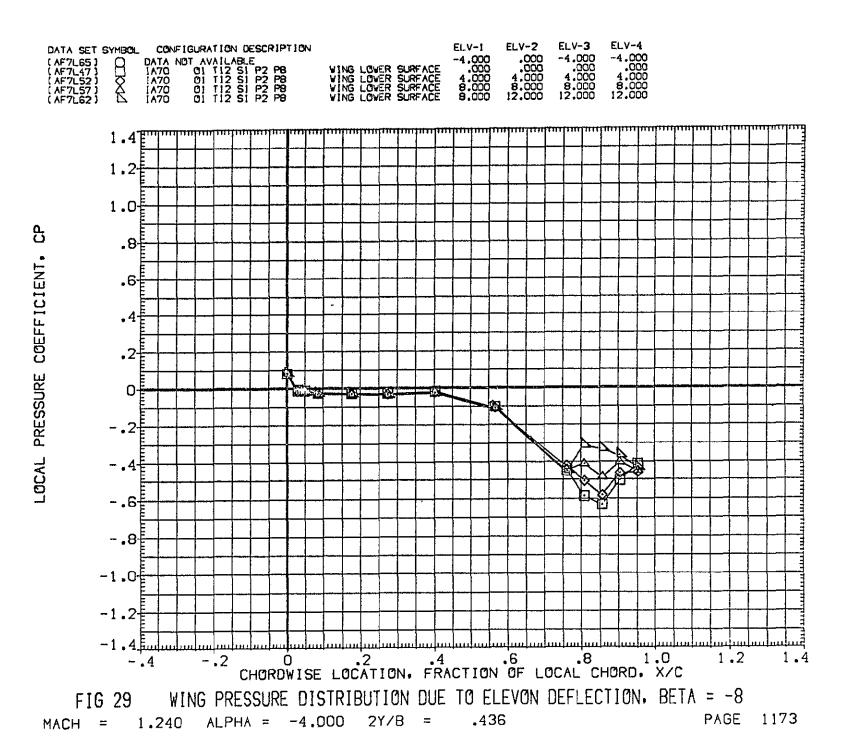


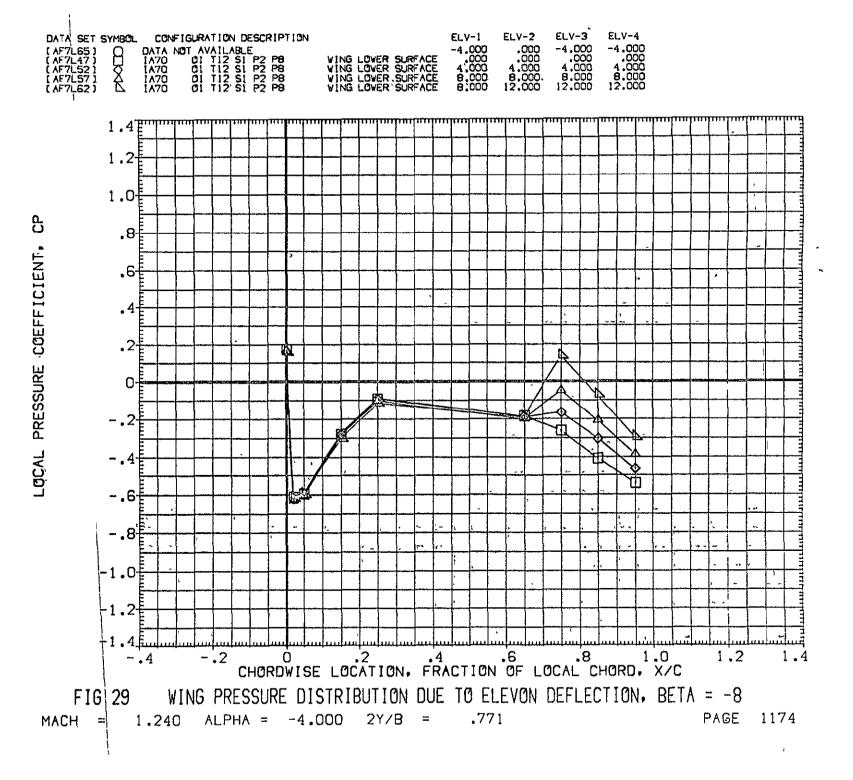


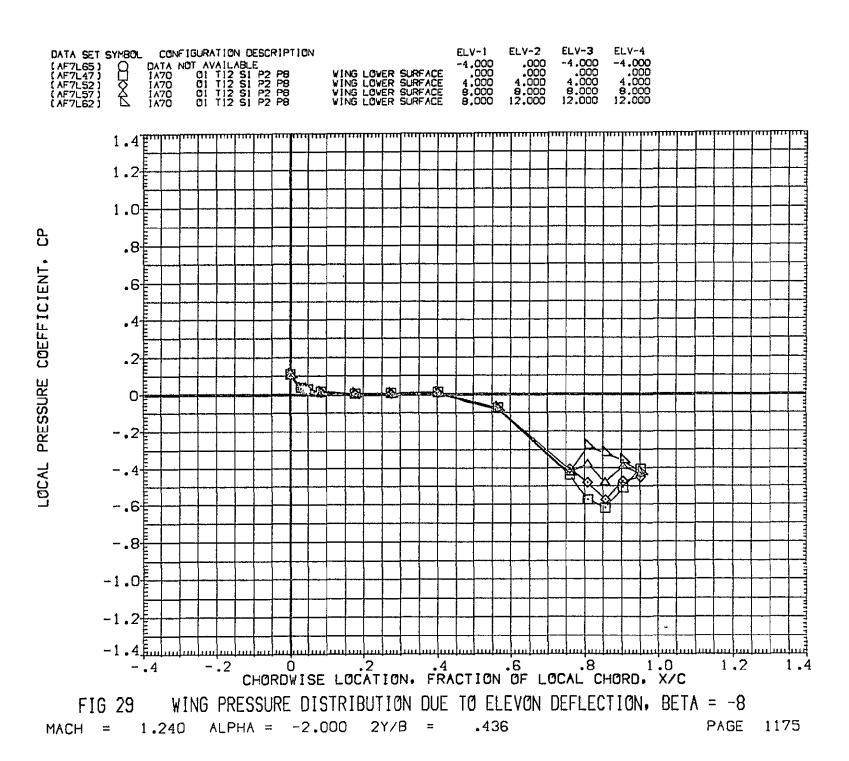


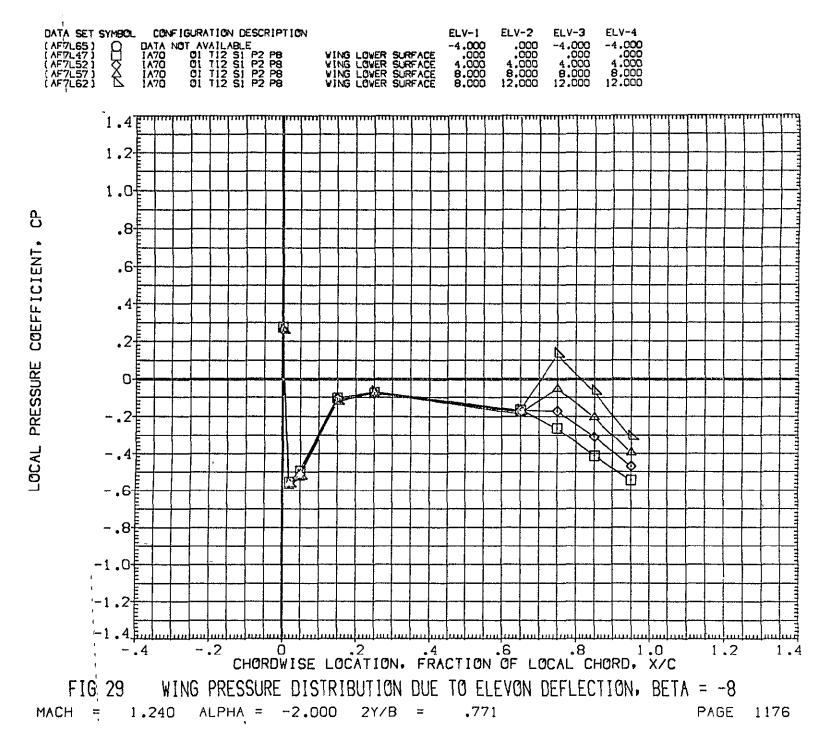


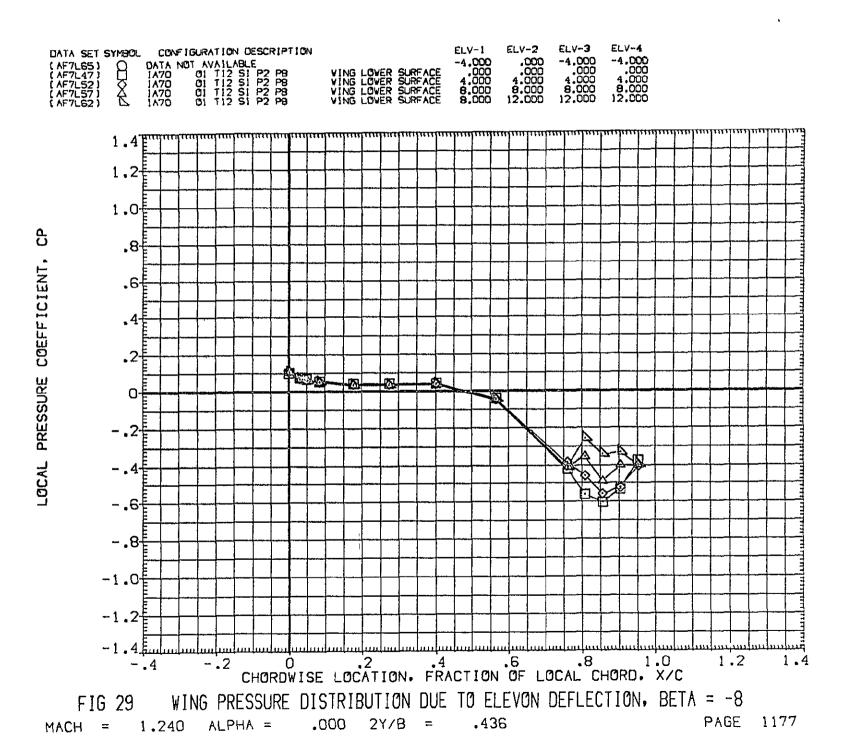


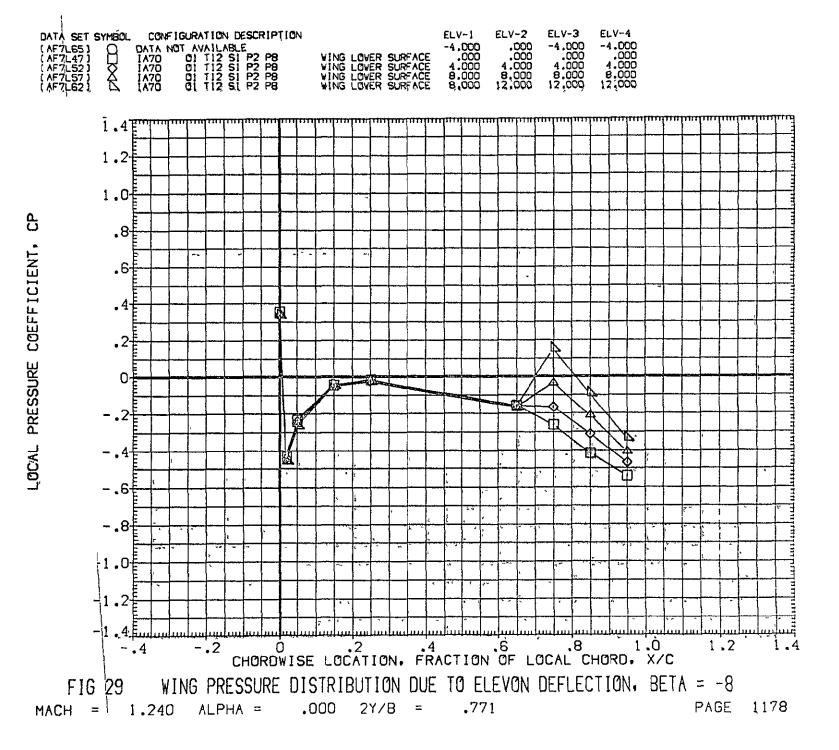


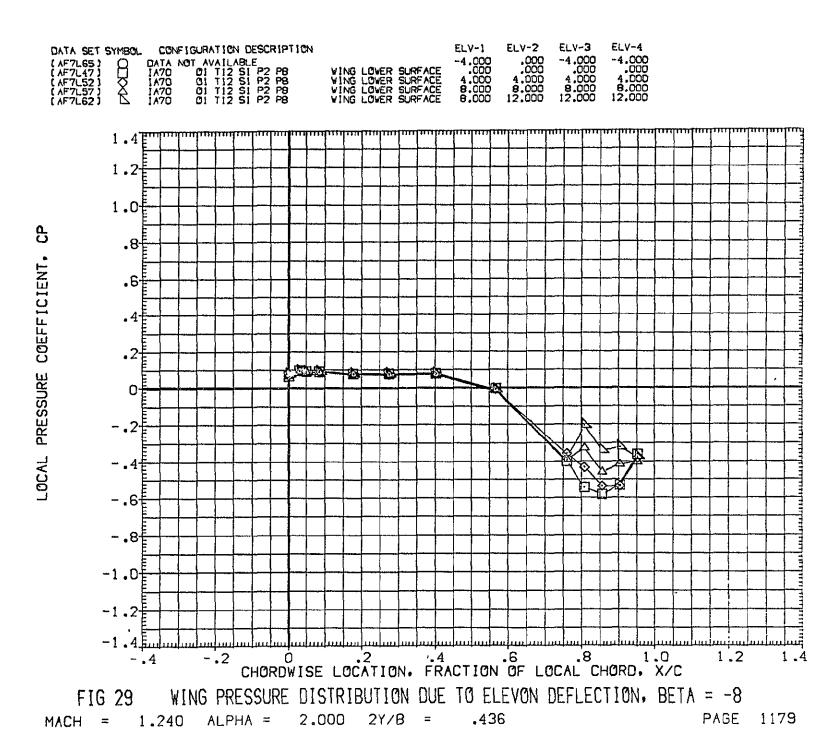


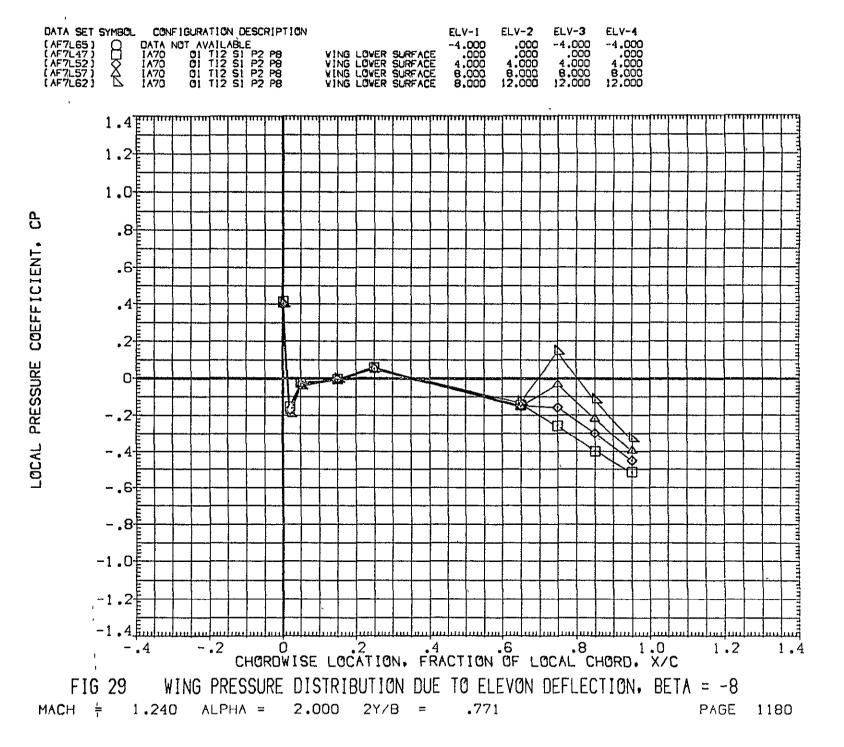


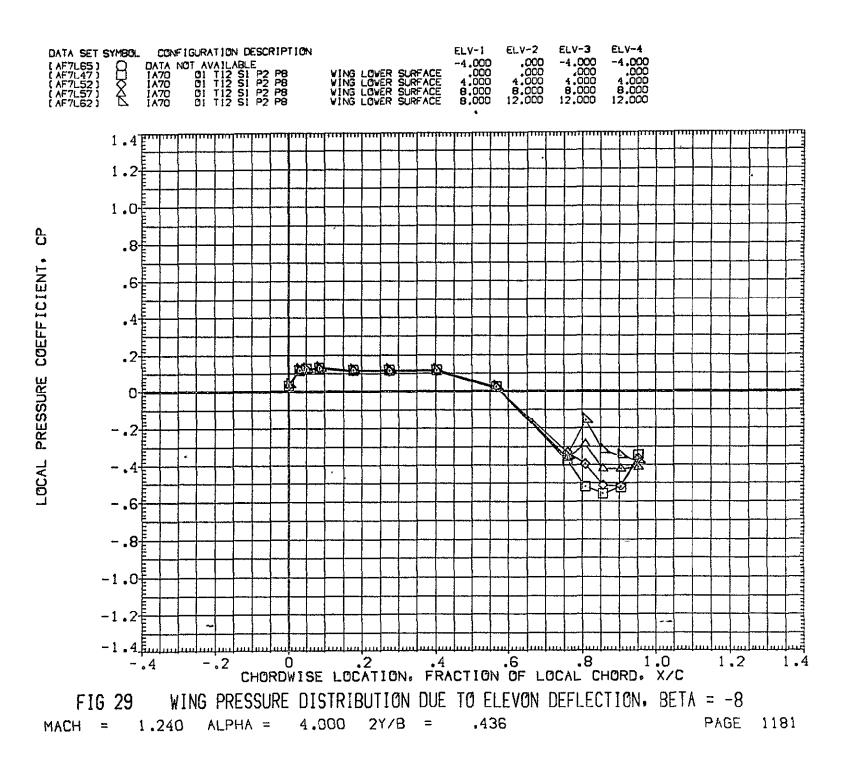


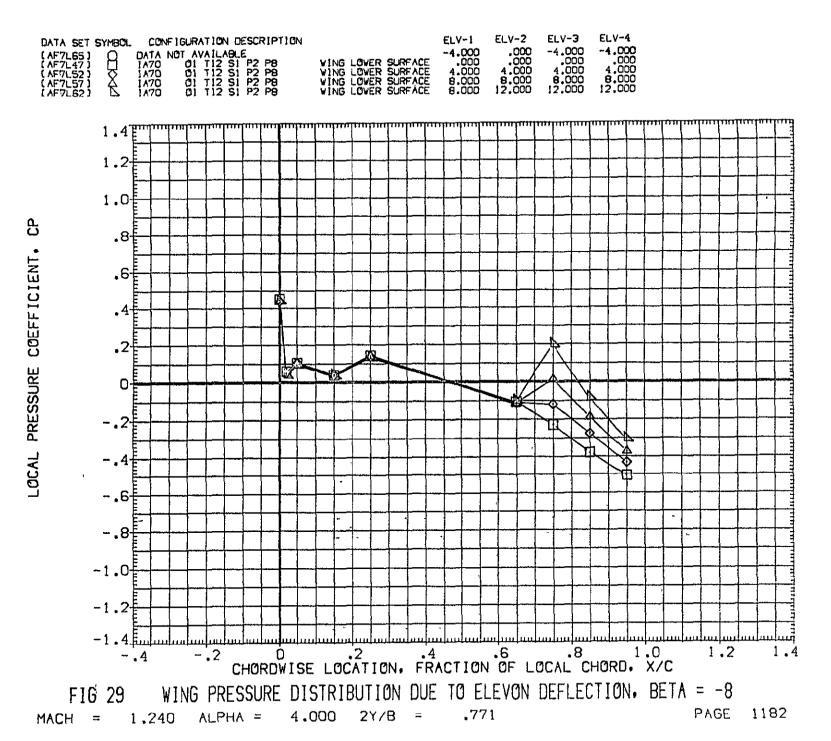


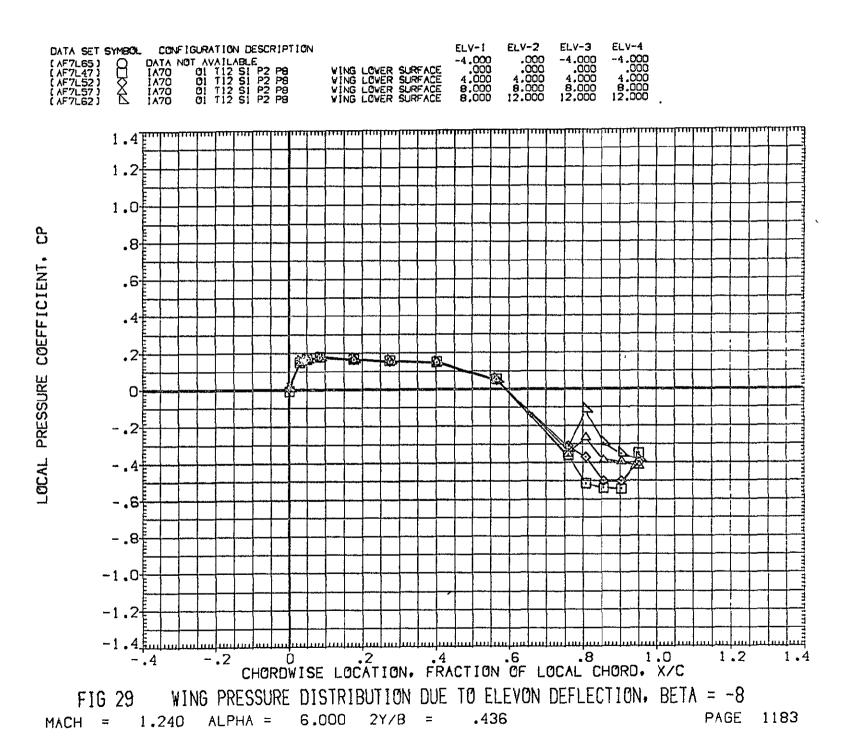


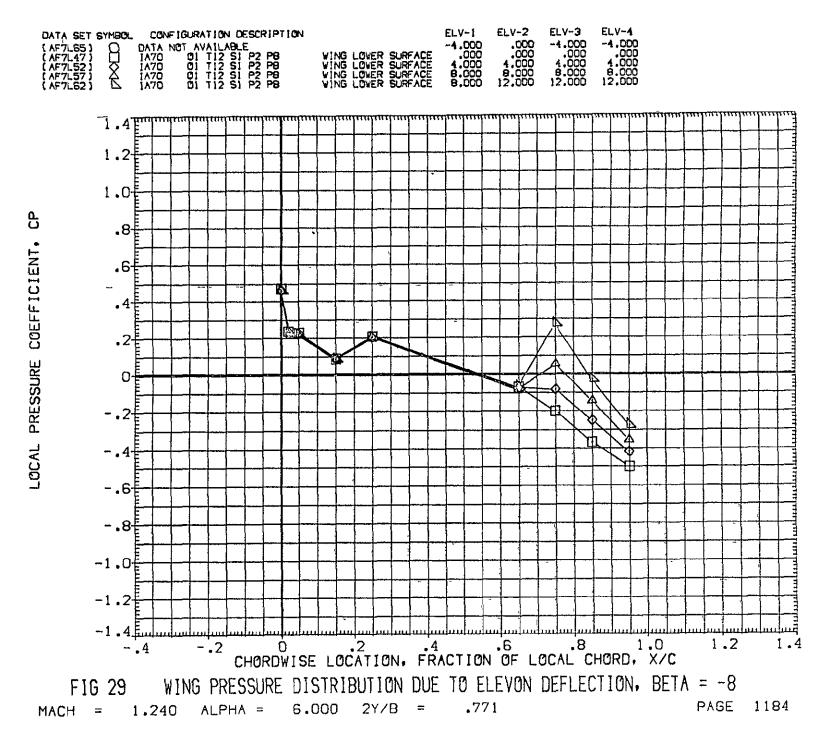


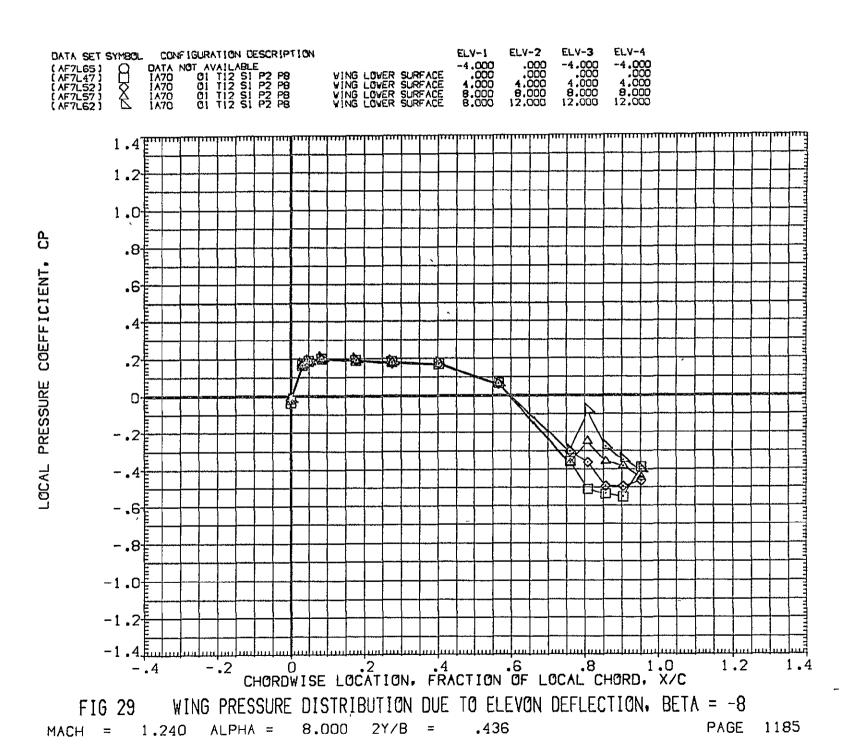


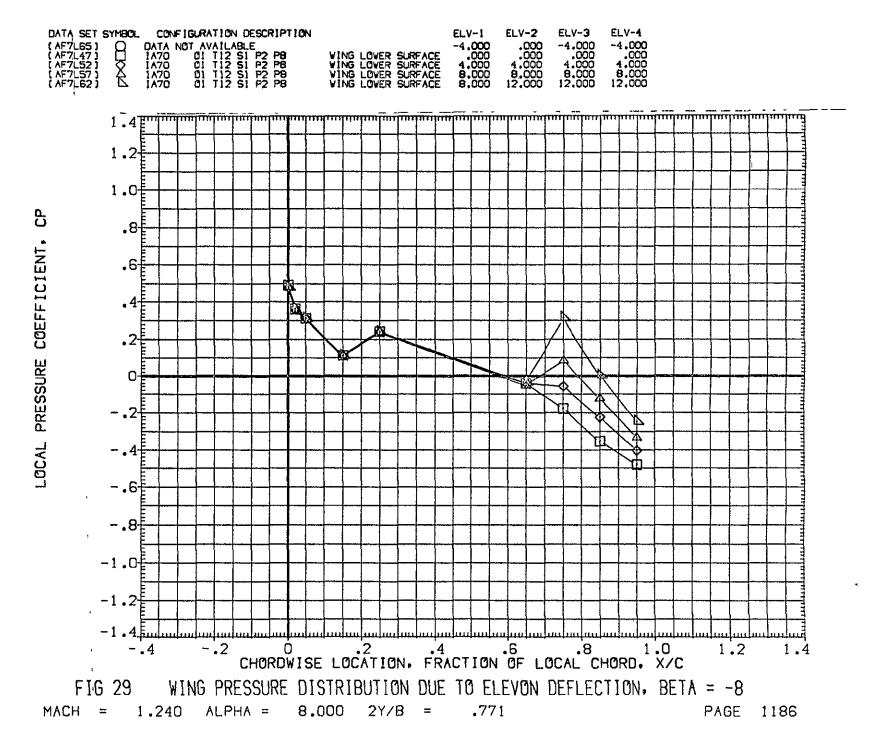


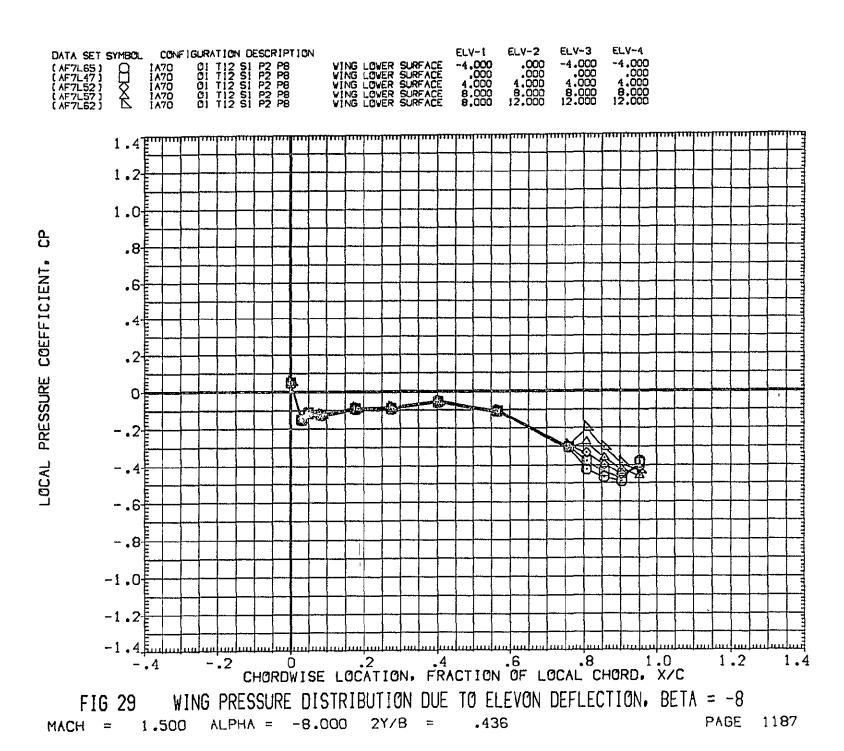


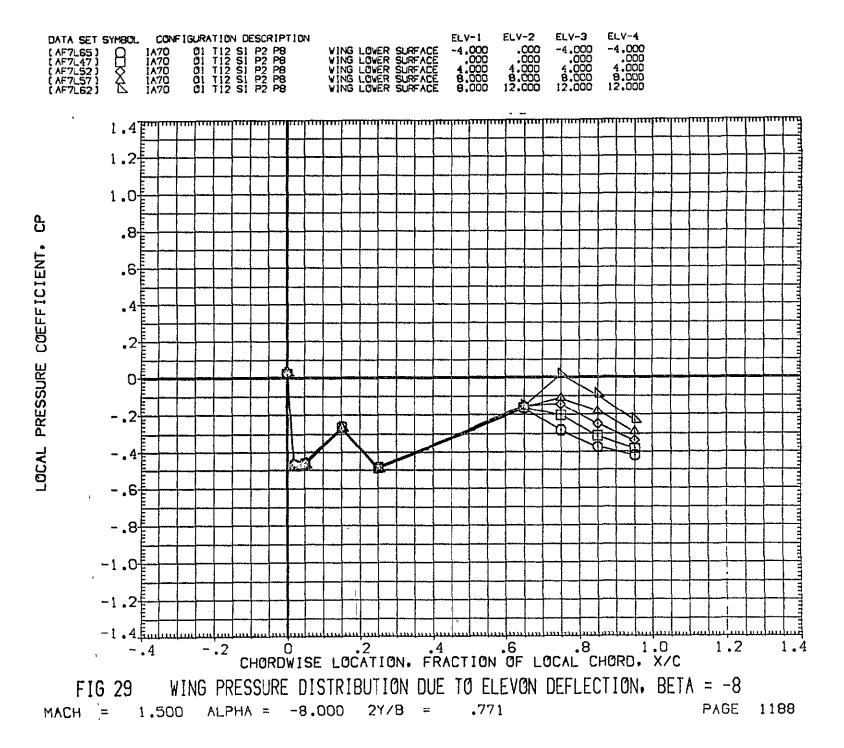


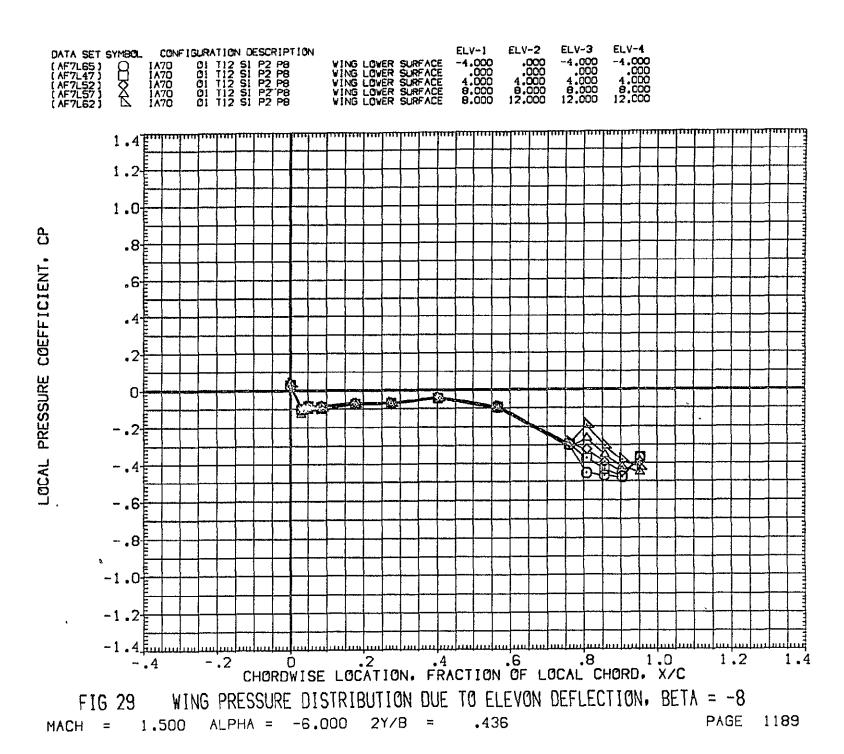


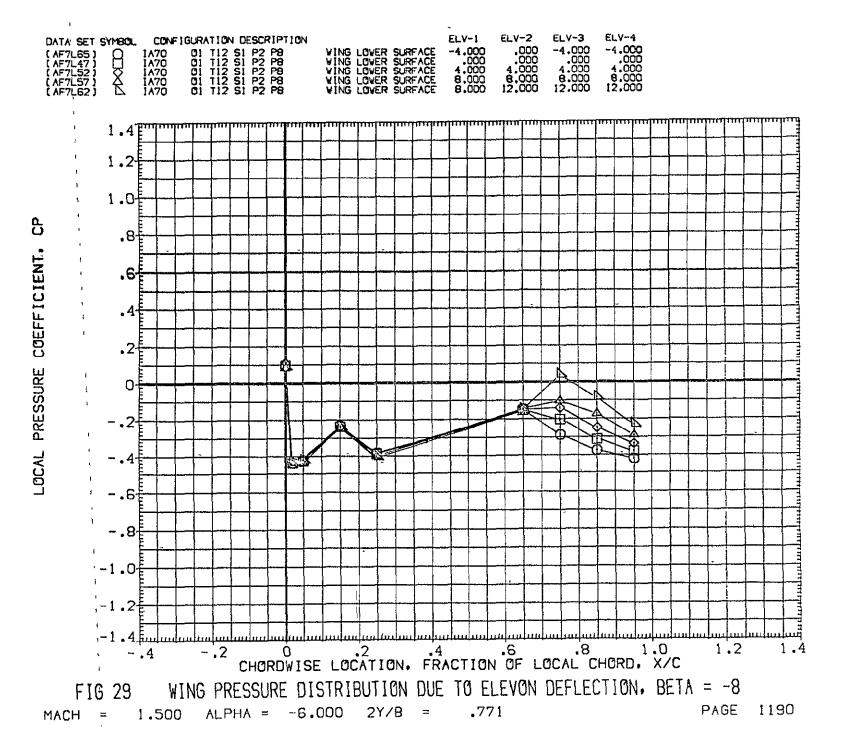


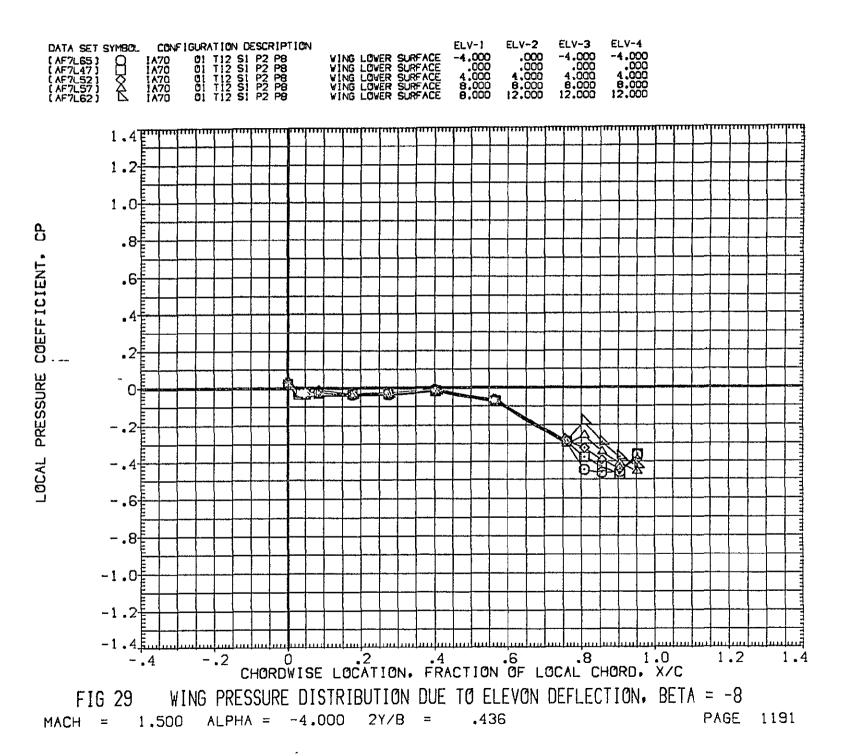


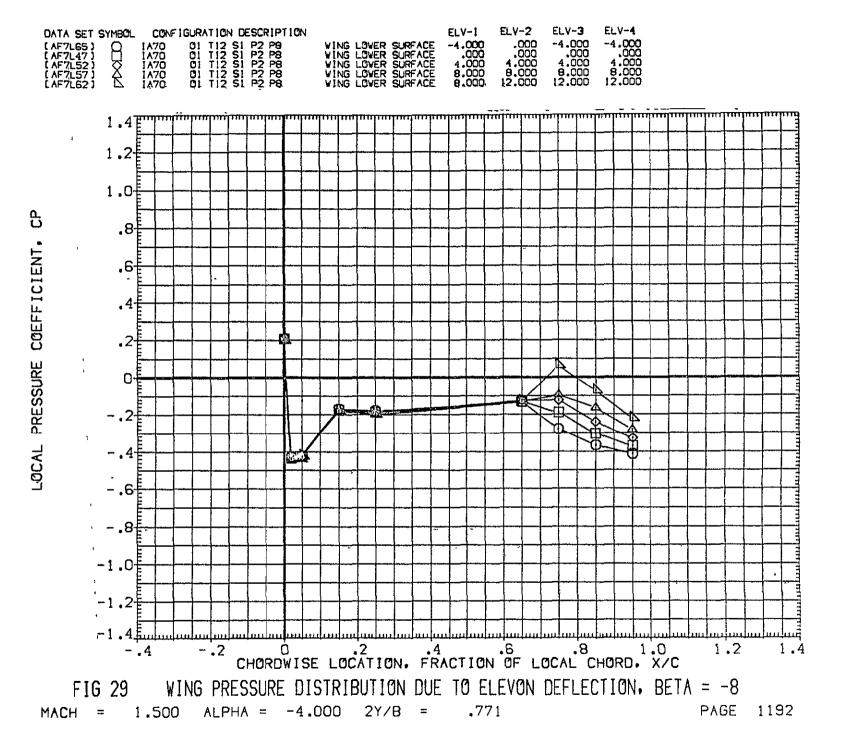


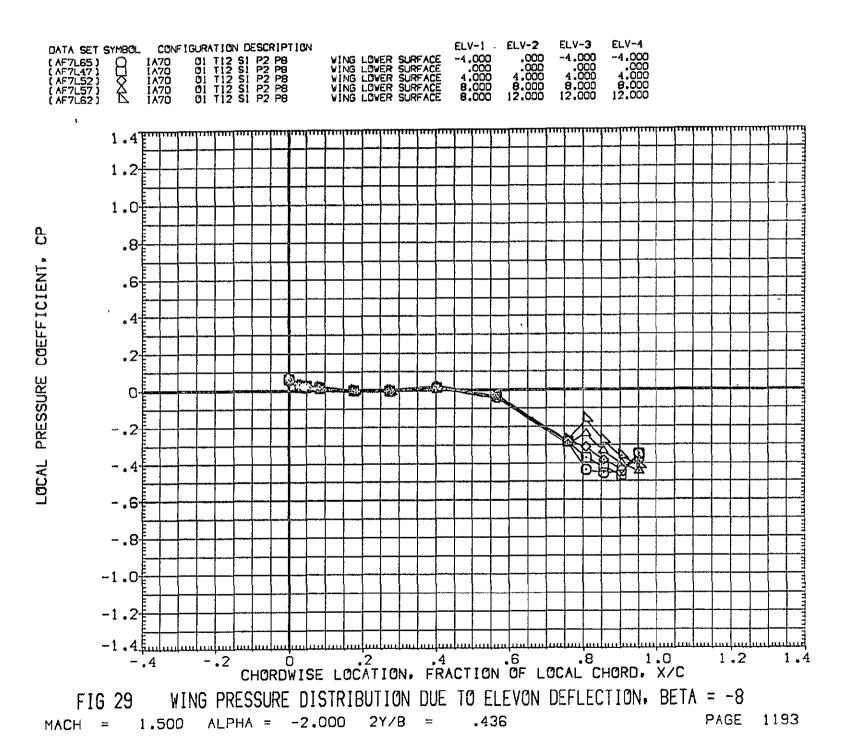


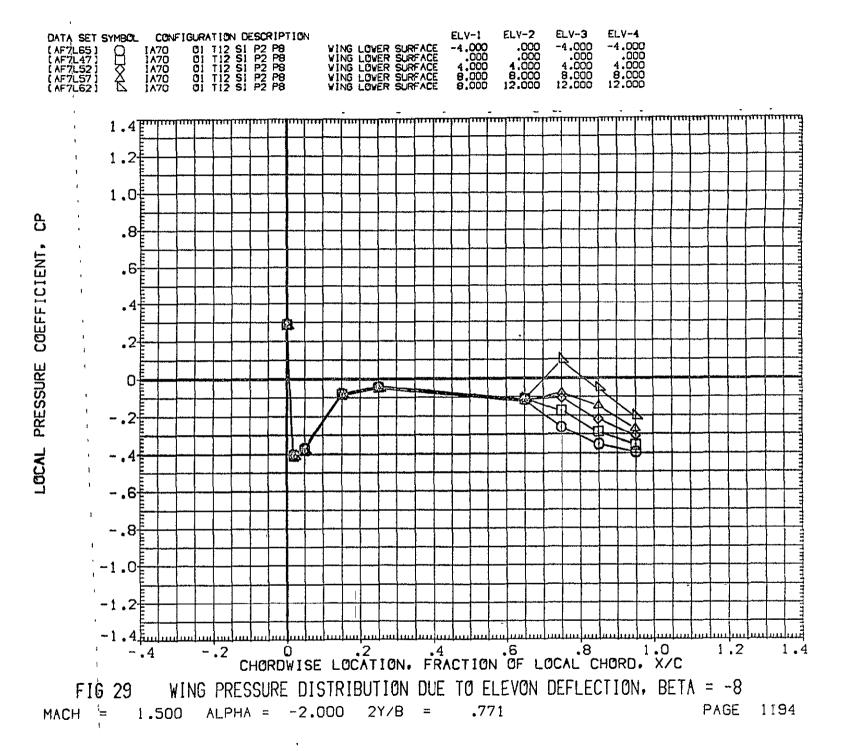


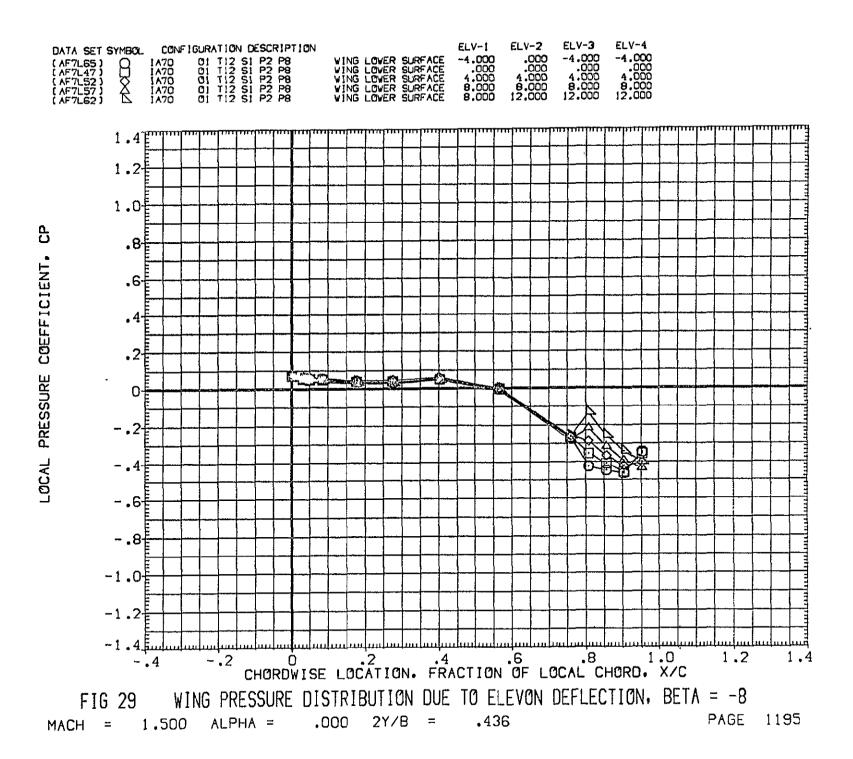


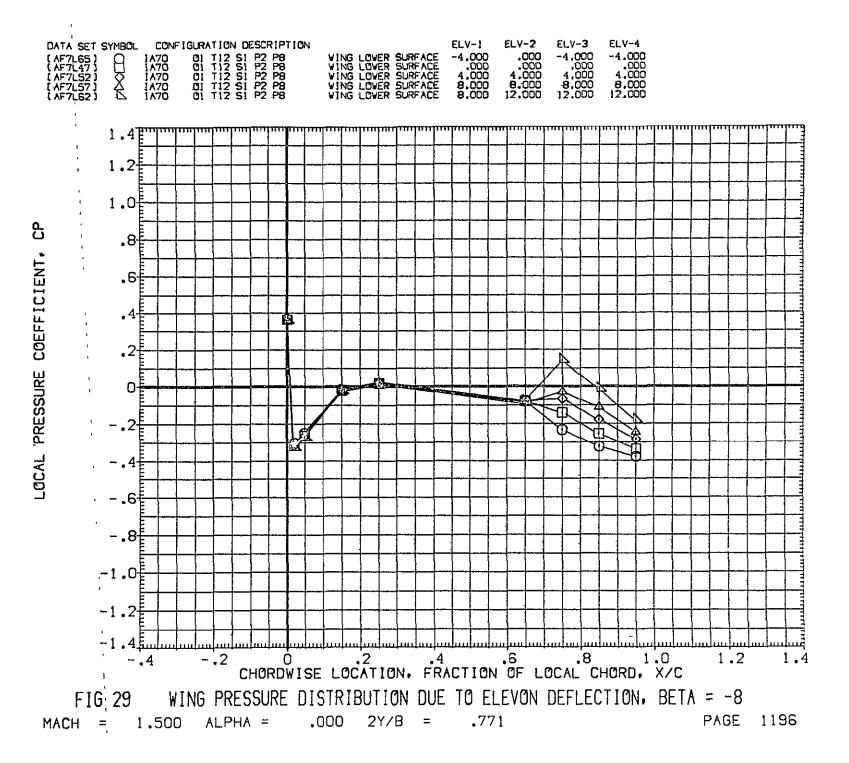


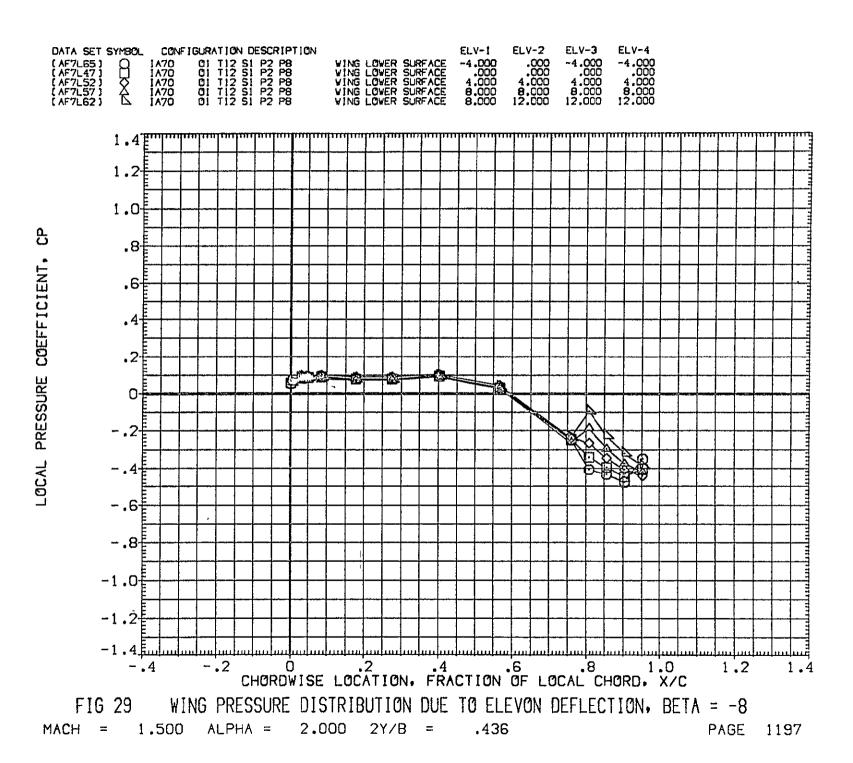


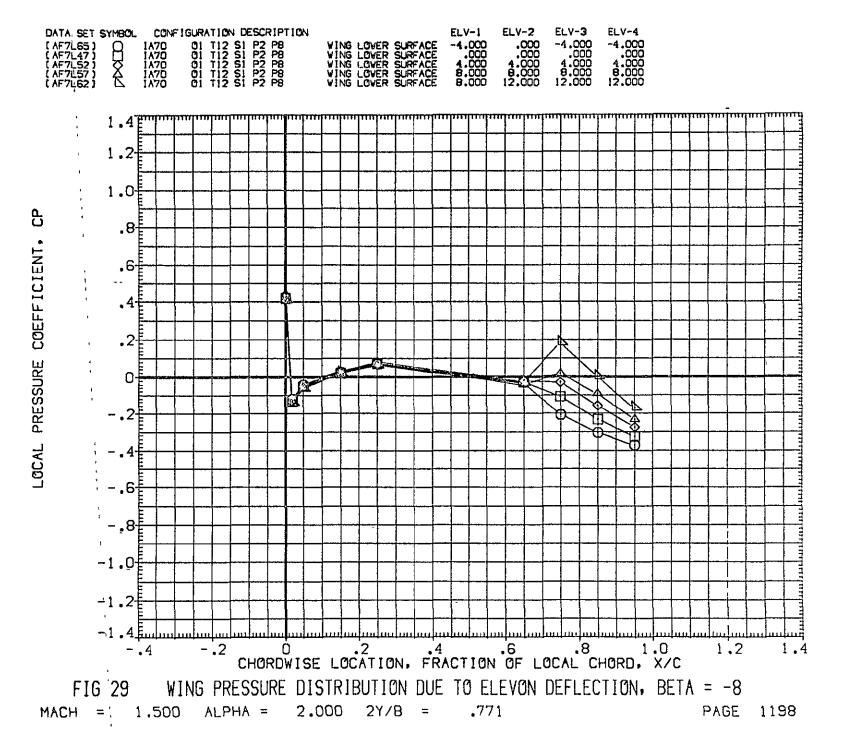


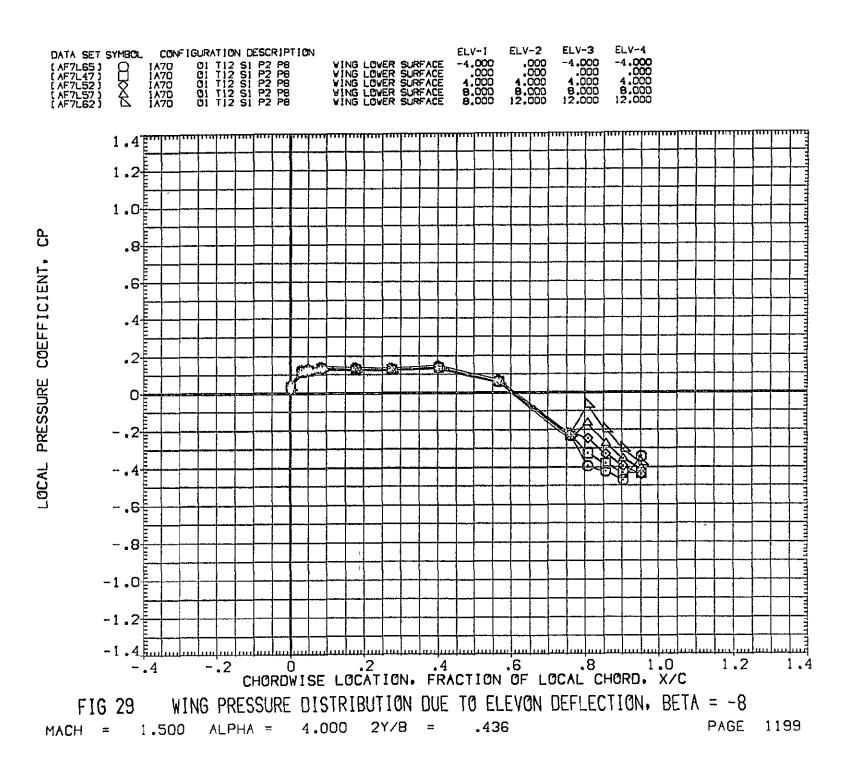


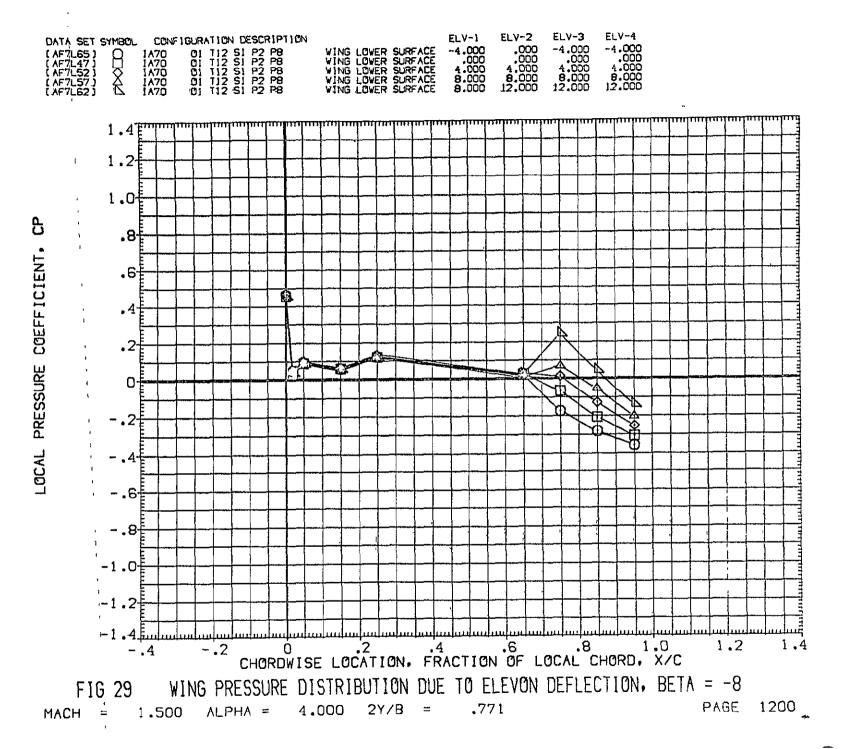


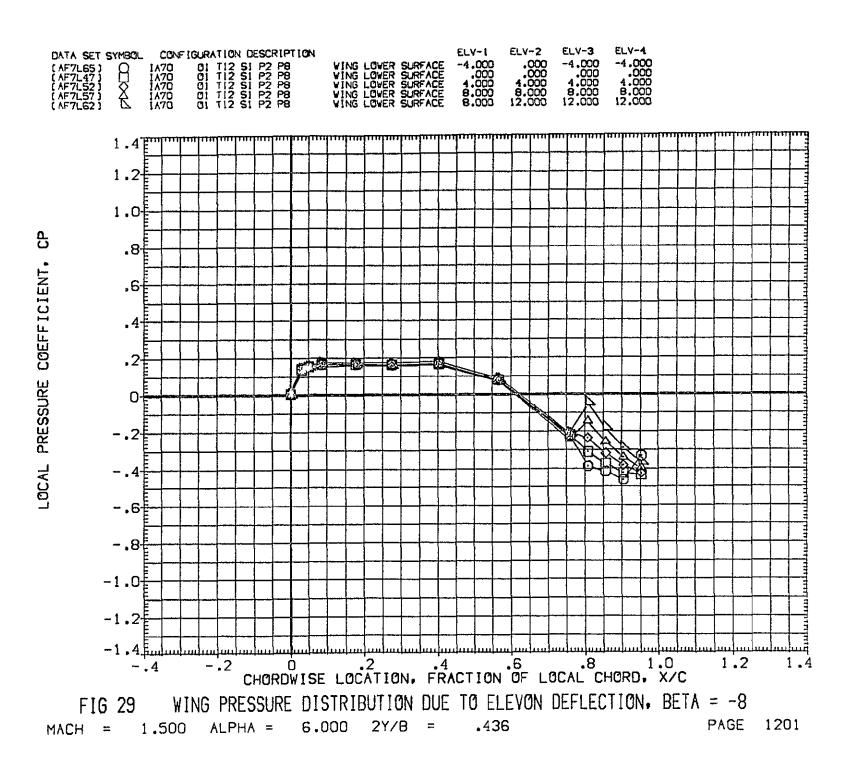


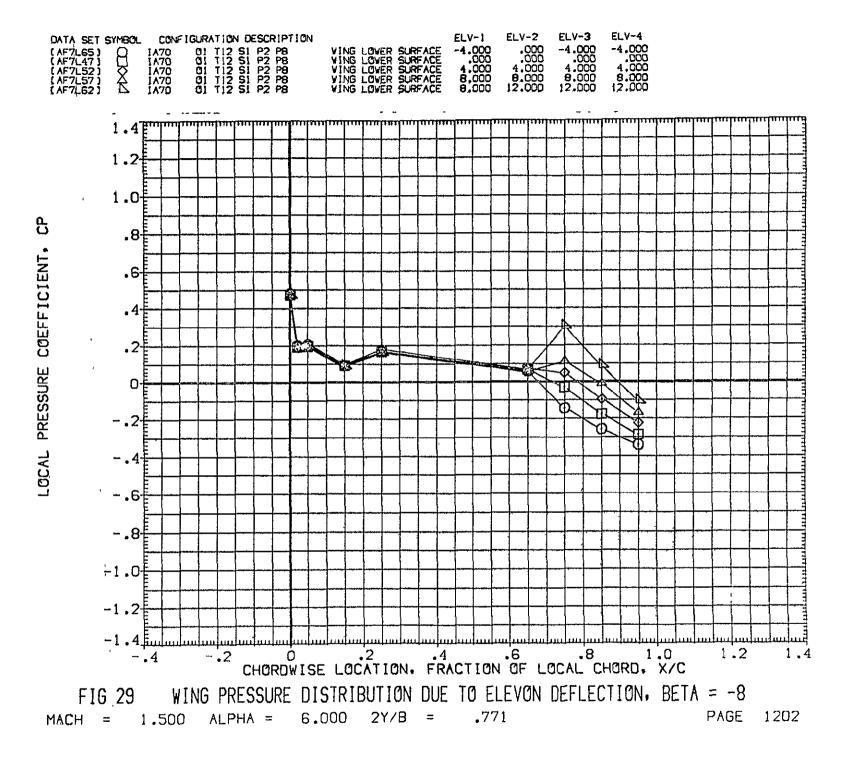


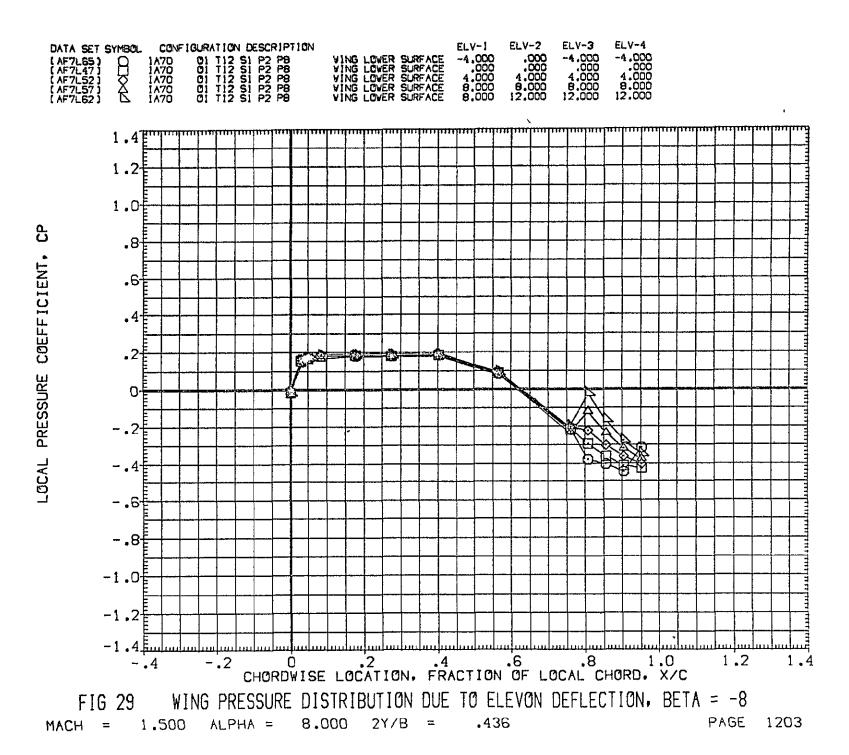


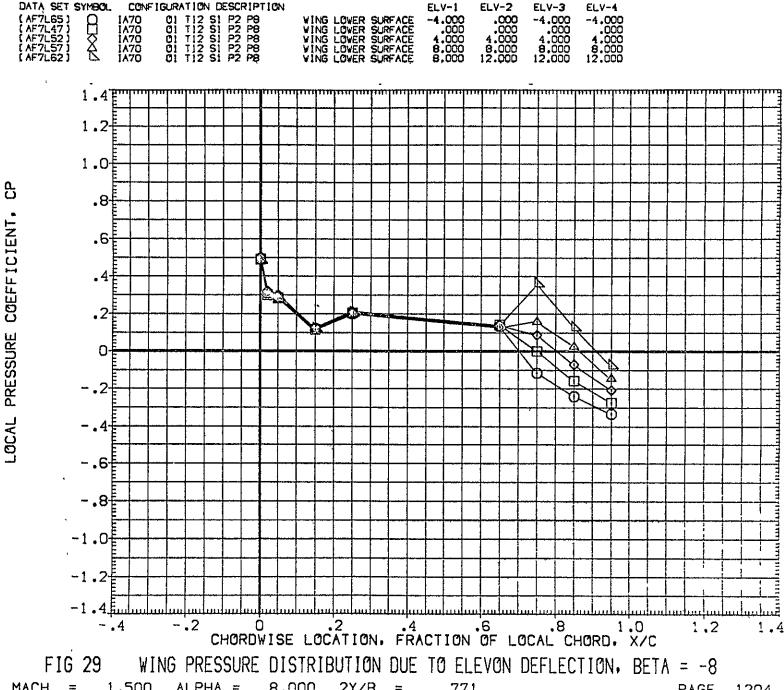




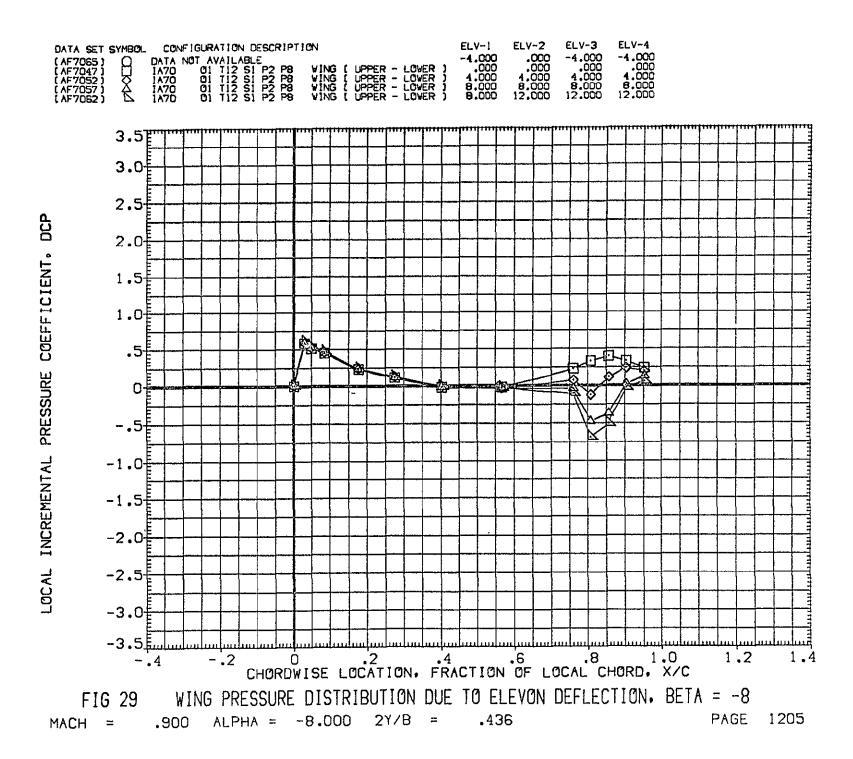


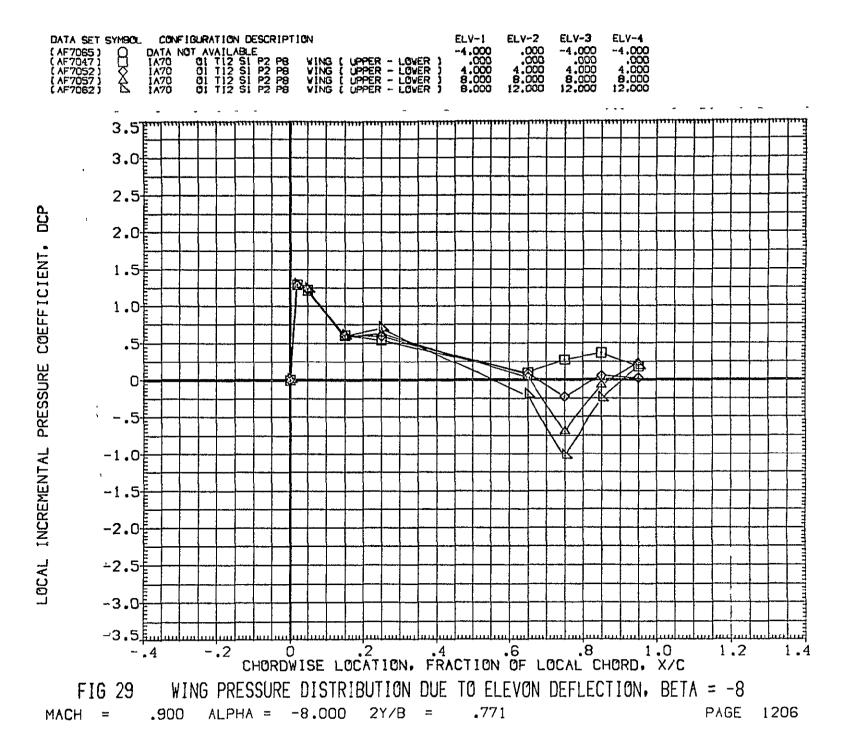


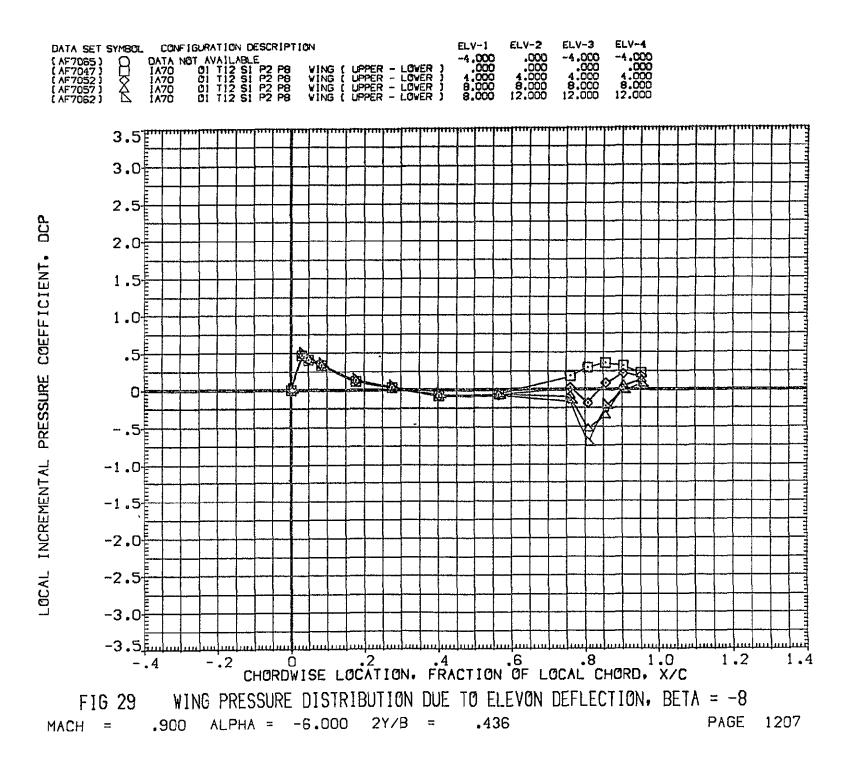


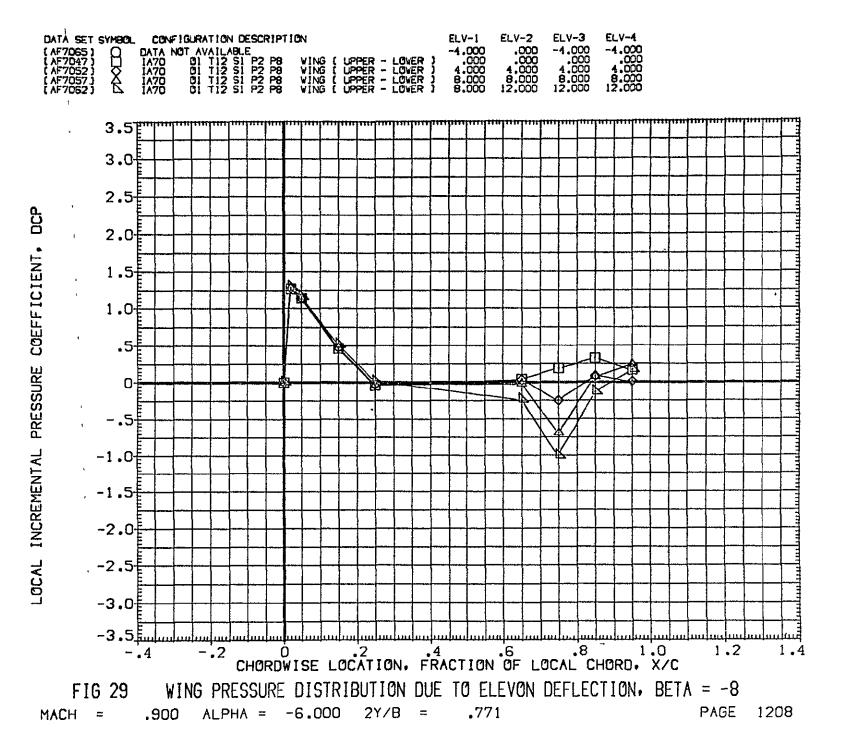


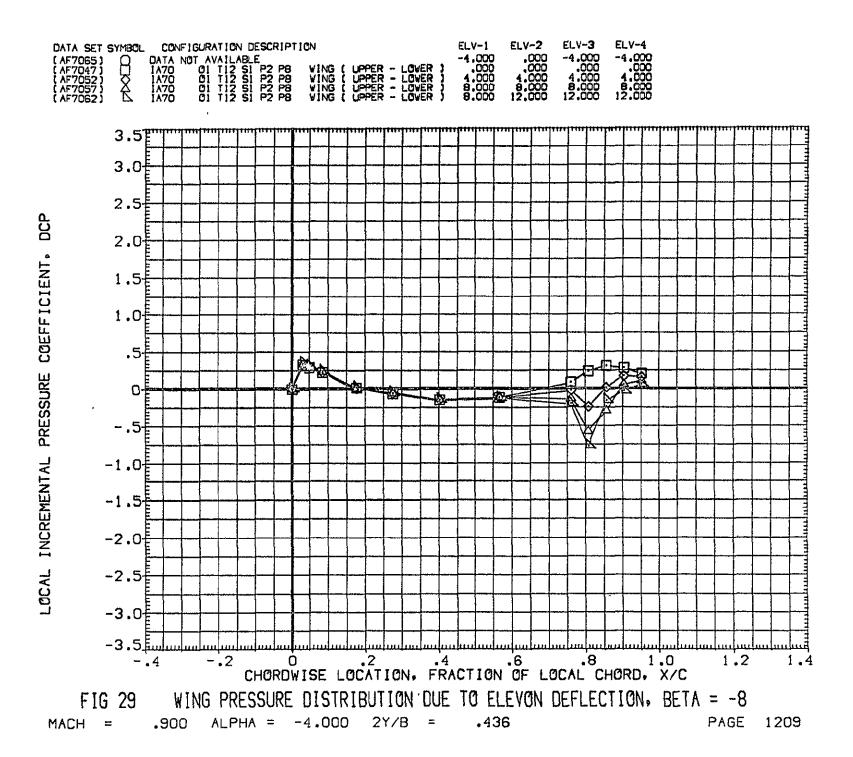
MACH = 1.500 ALPHA = 8.000 2Y/B = .771 PAGE 1204

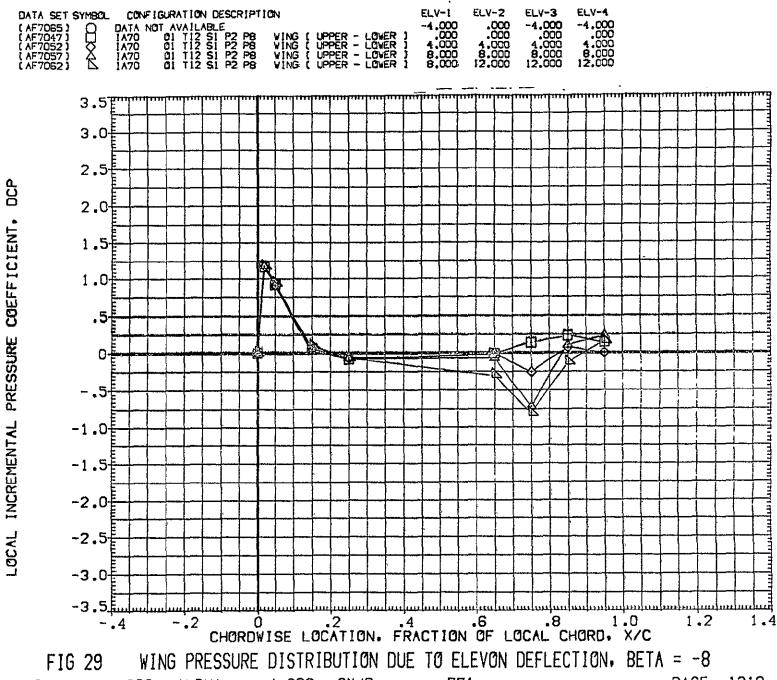




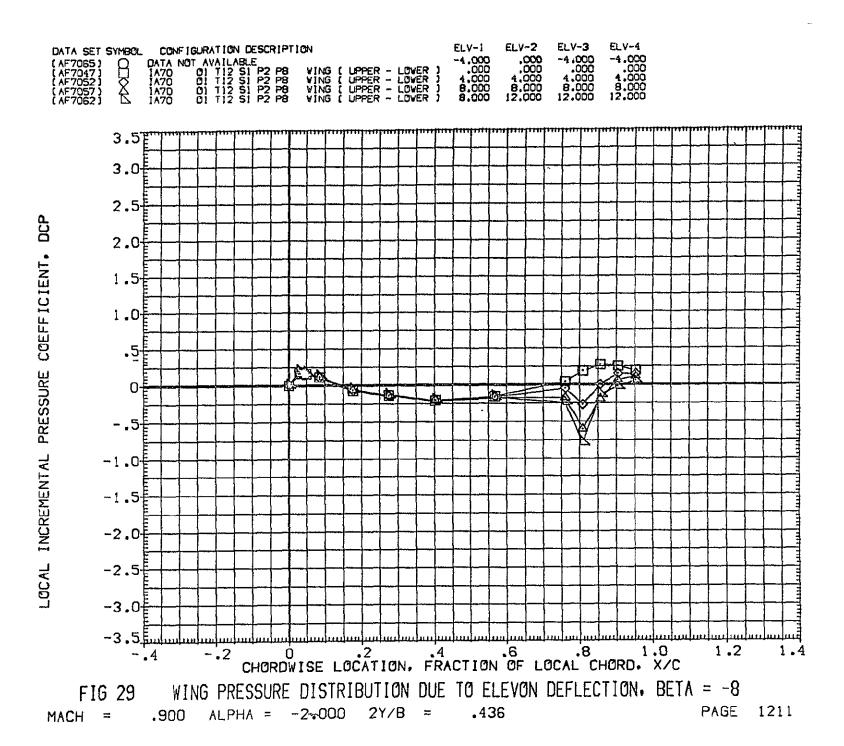


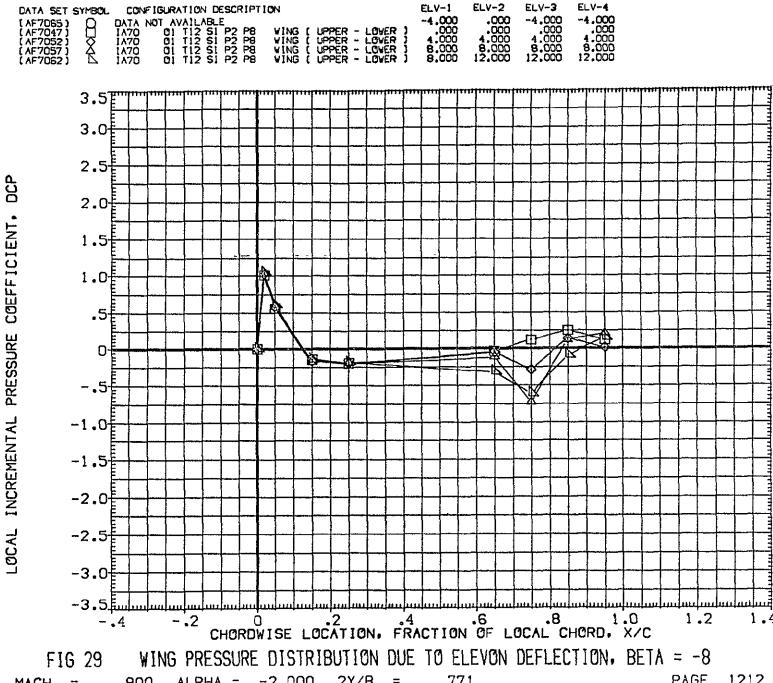




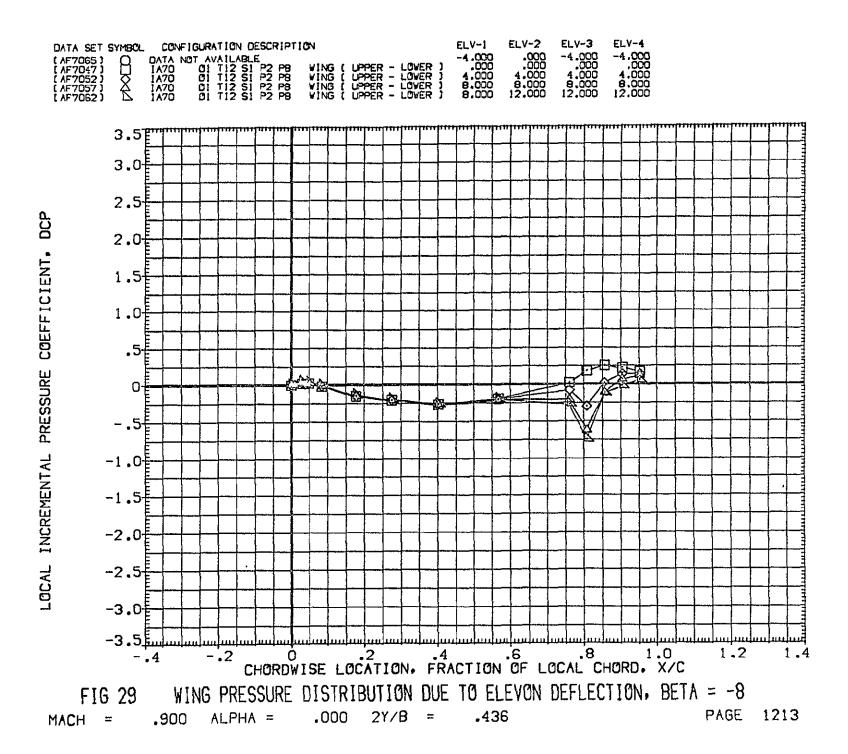


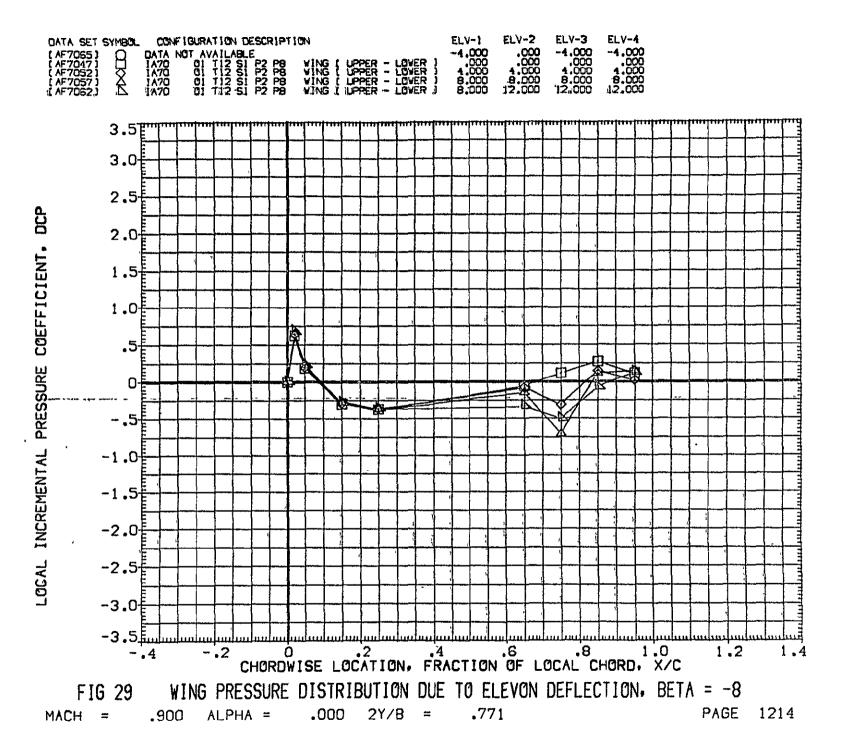
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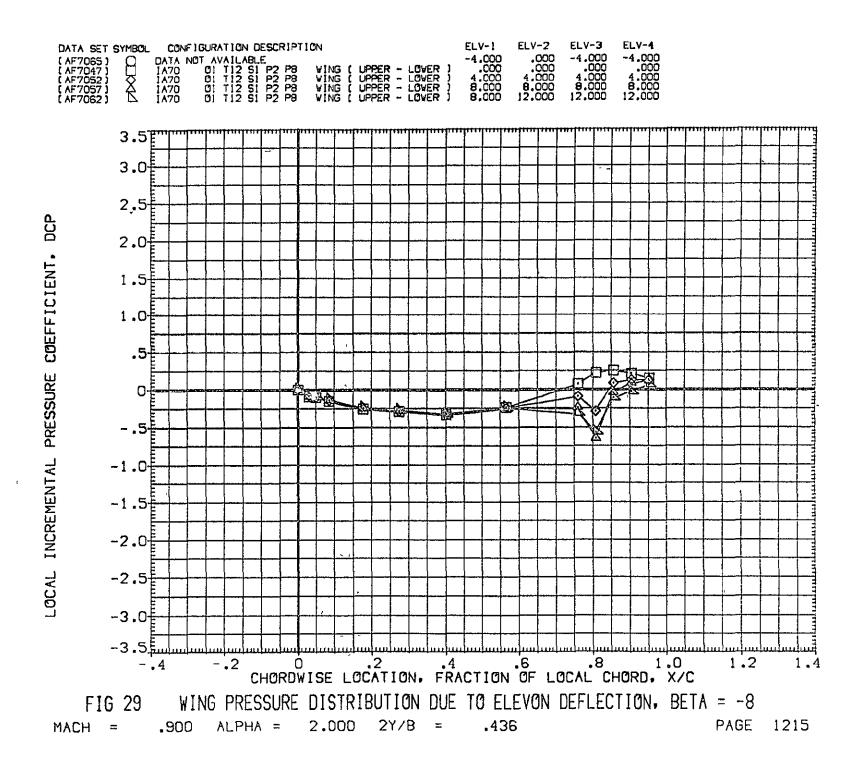


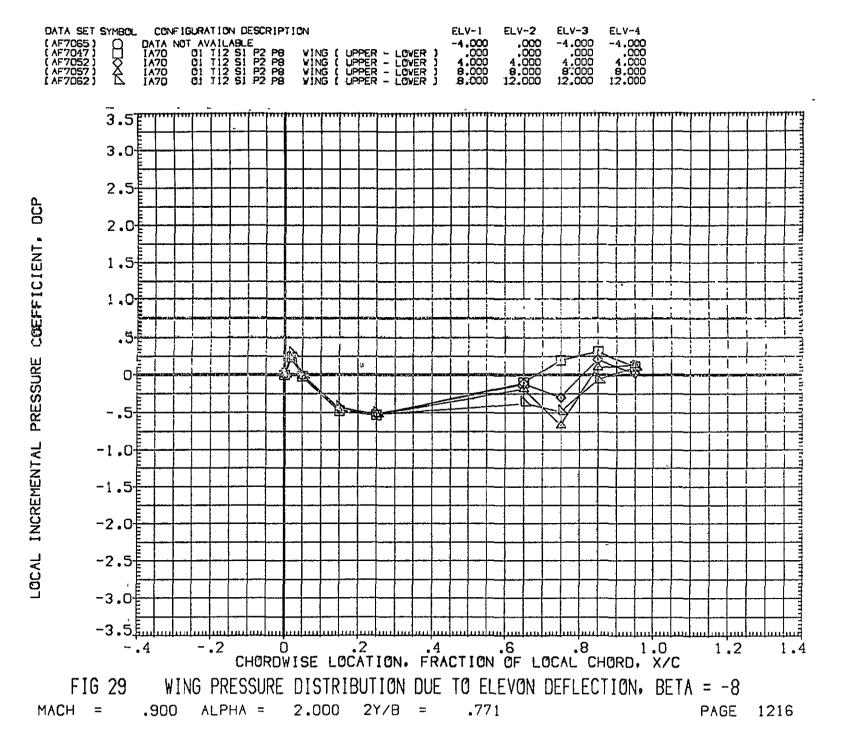


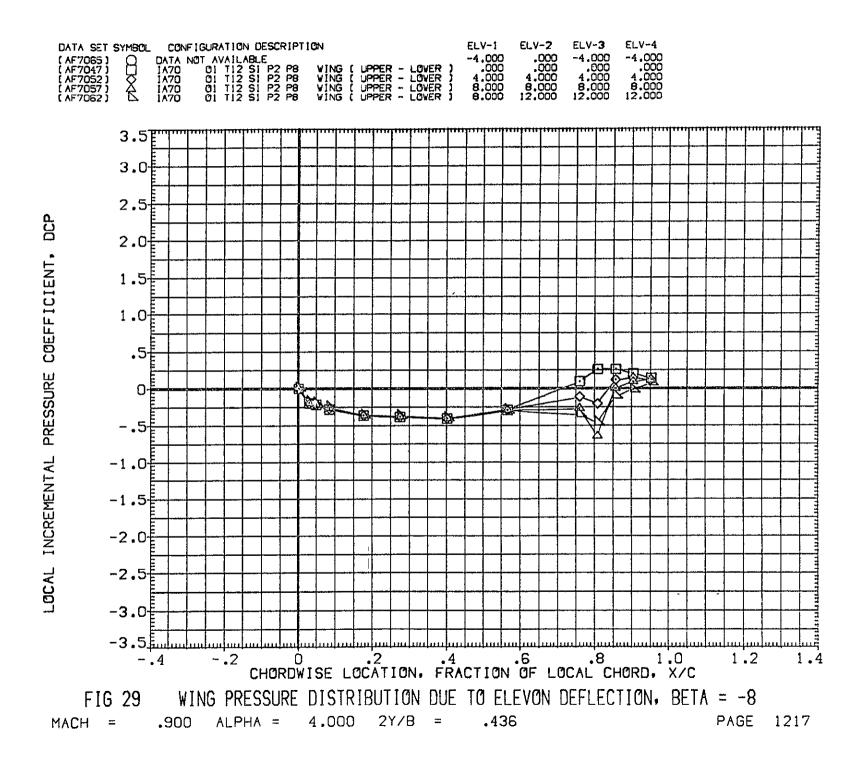
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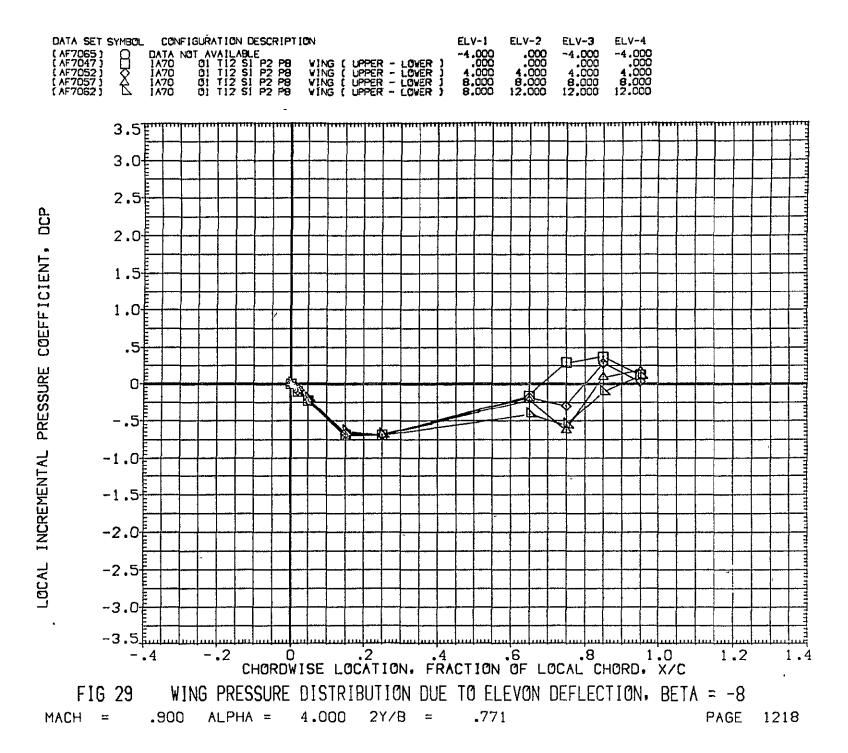


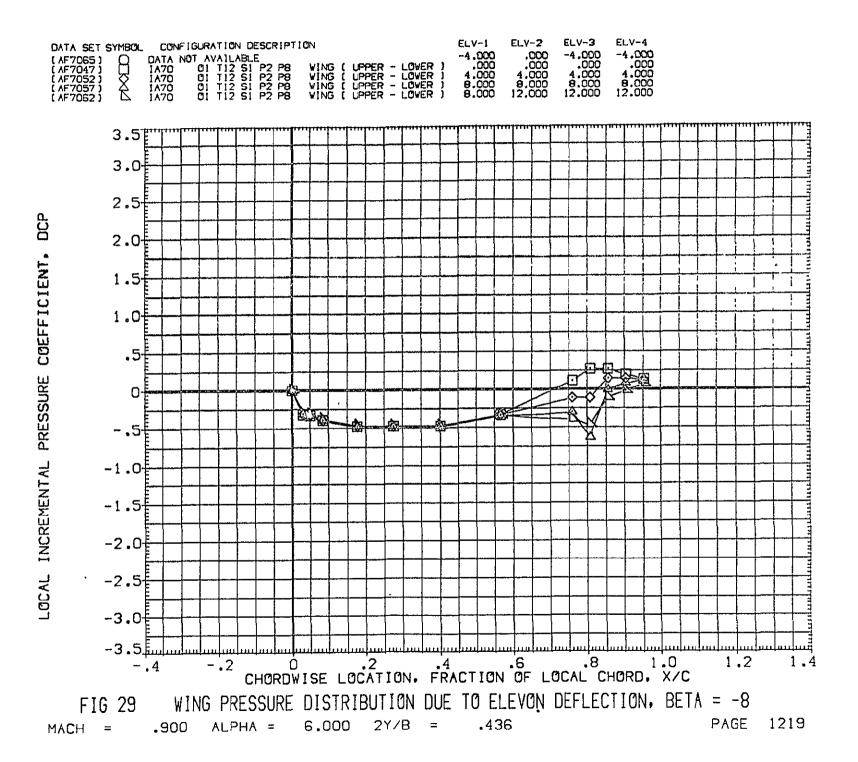


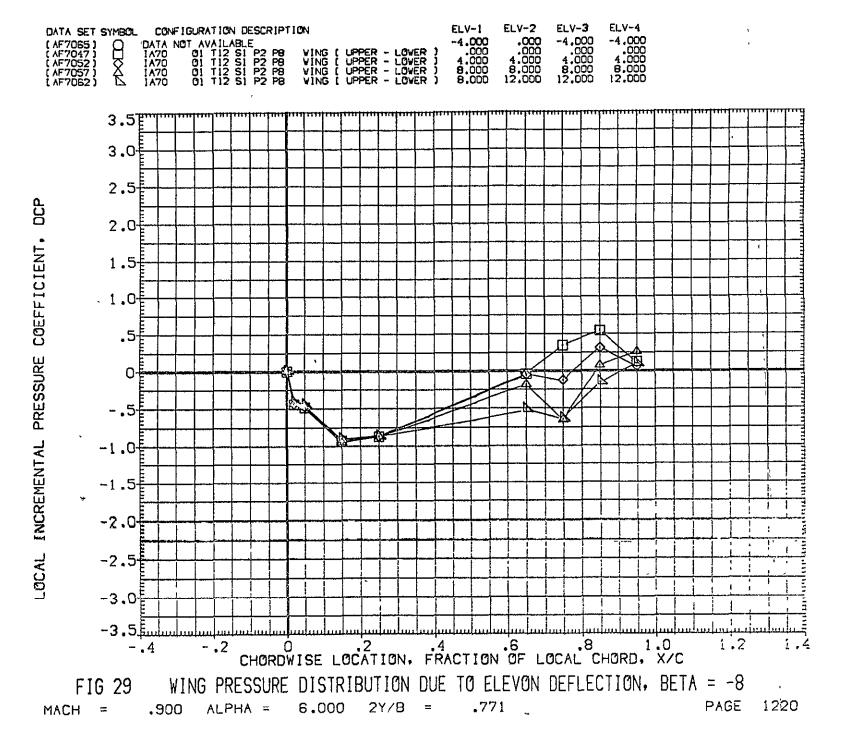


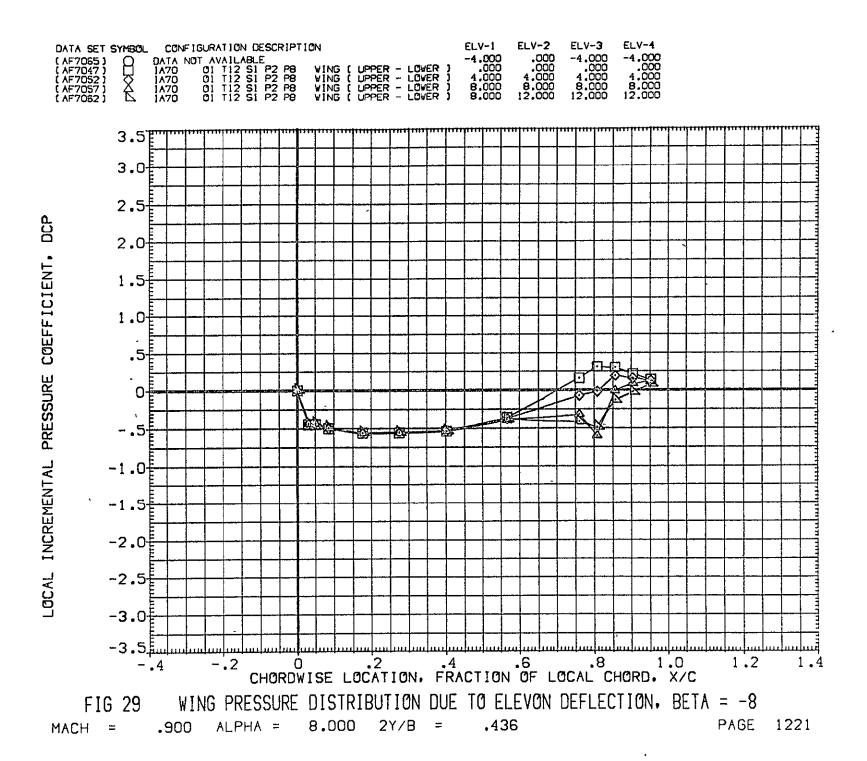


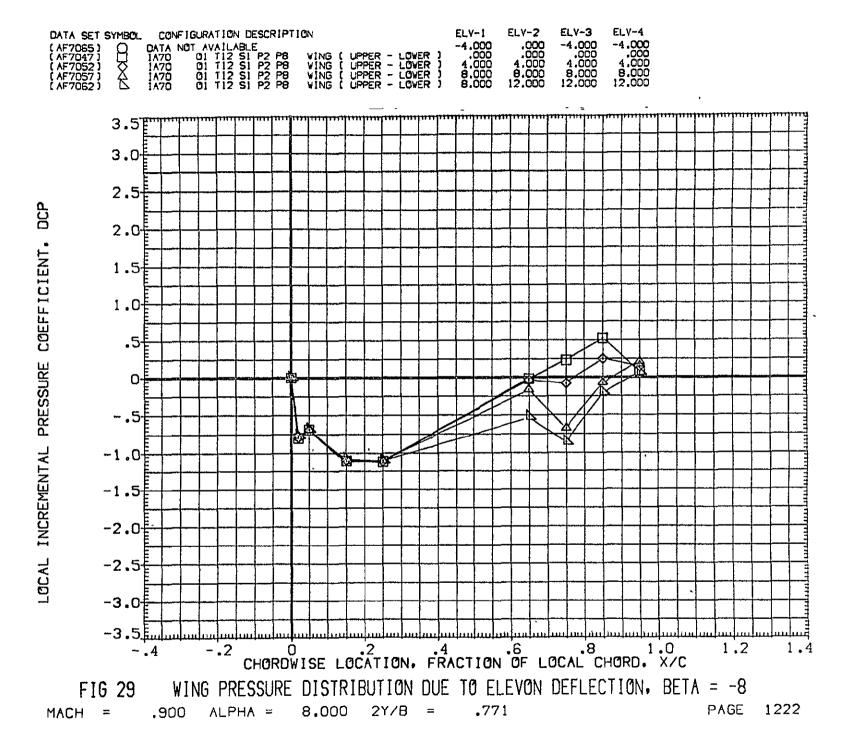


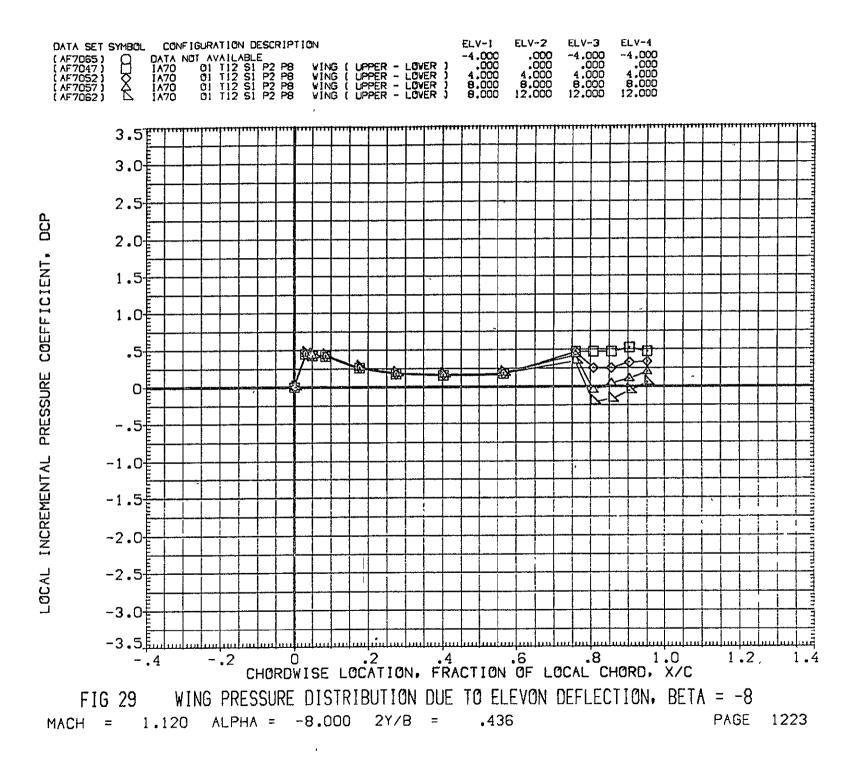


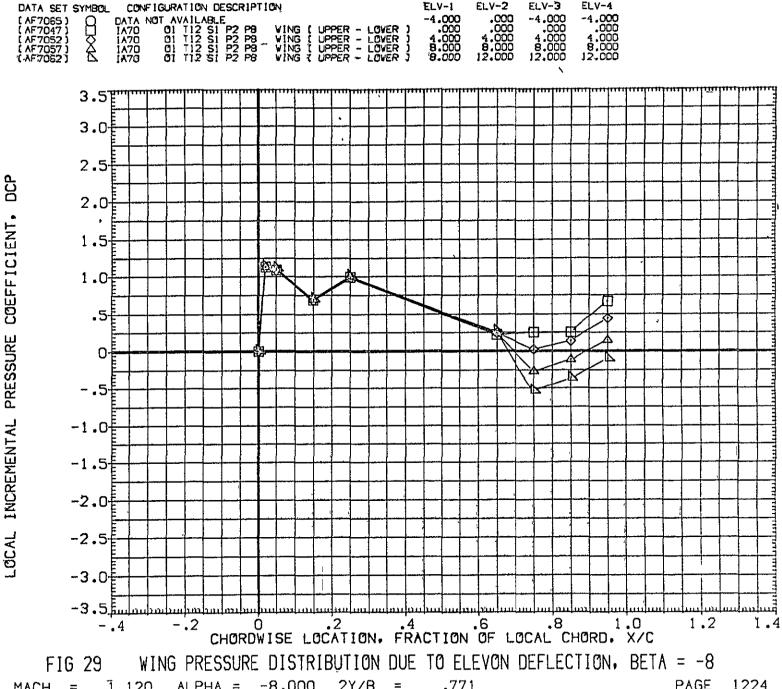




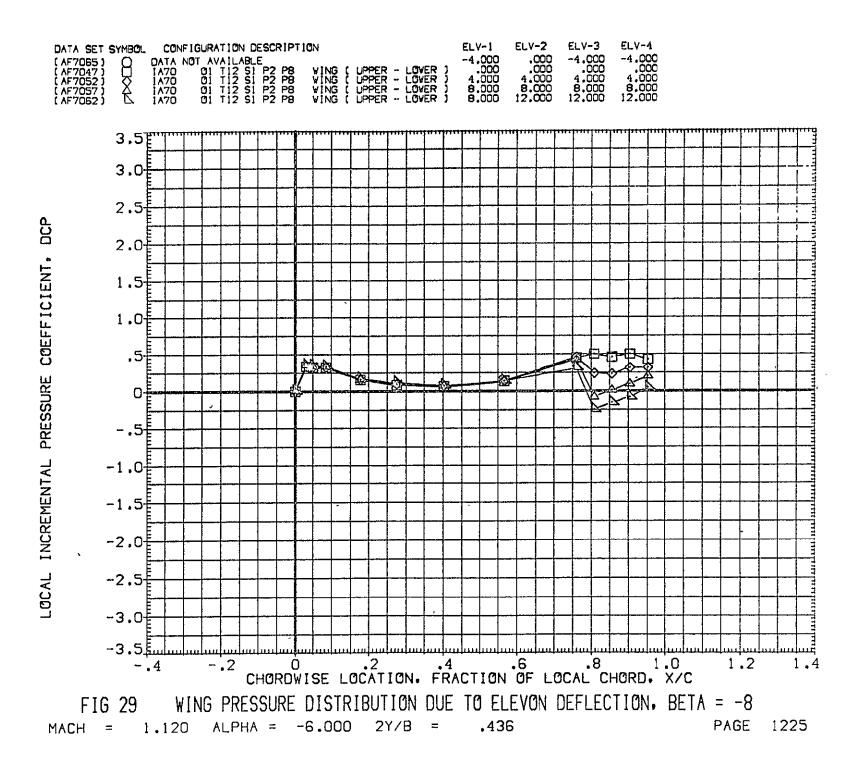


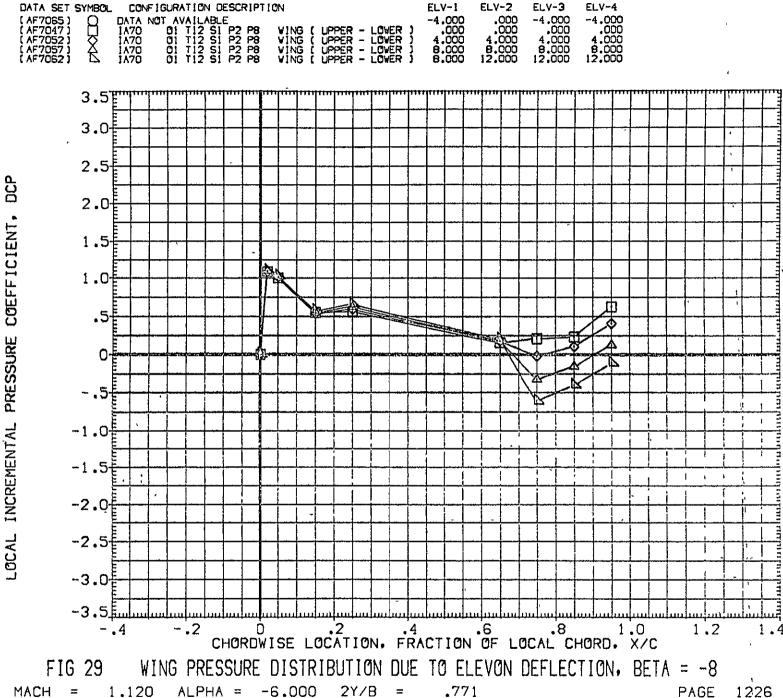




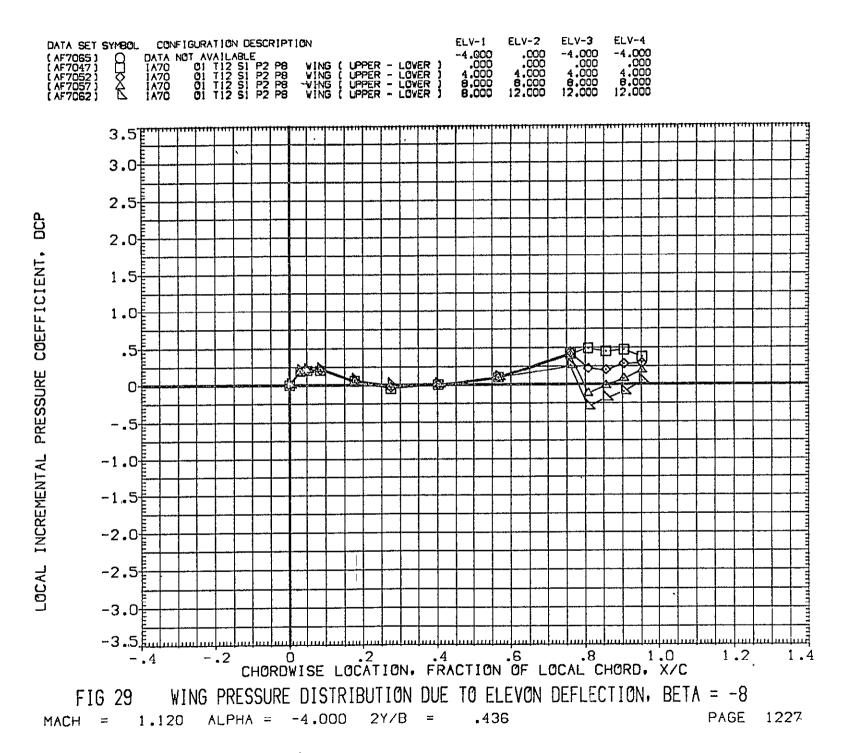


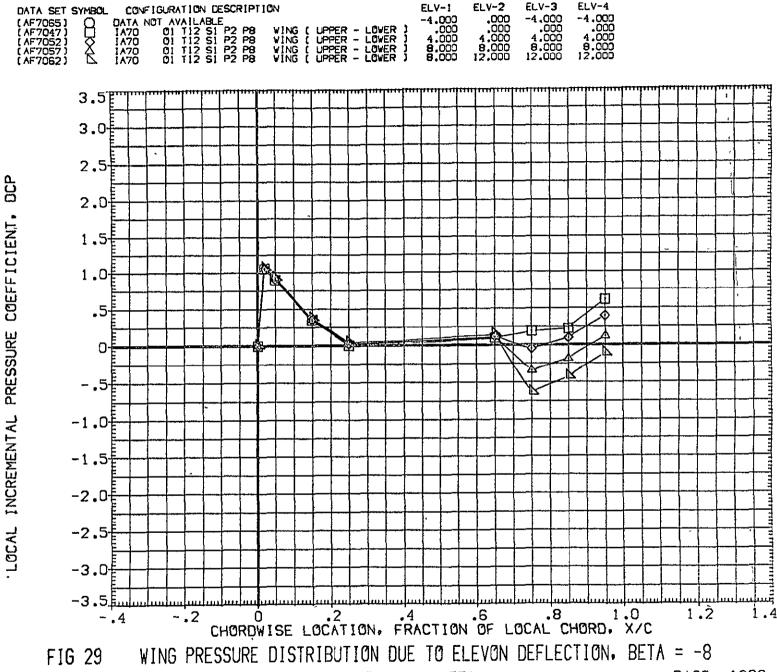
MACH = 1.120 ALPHA = -8.000 2Y/B =.771 PAGE 1224



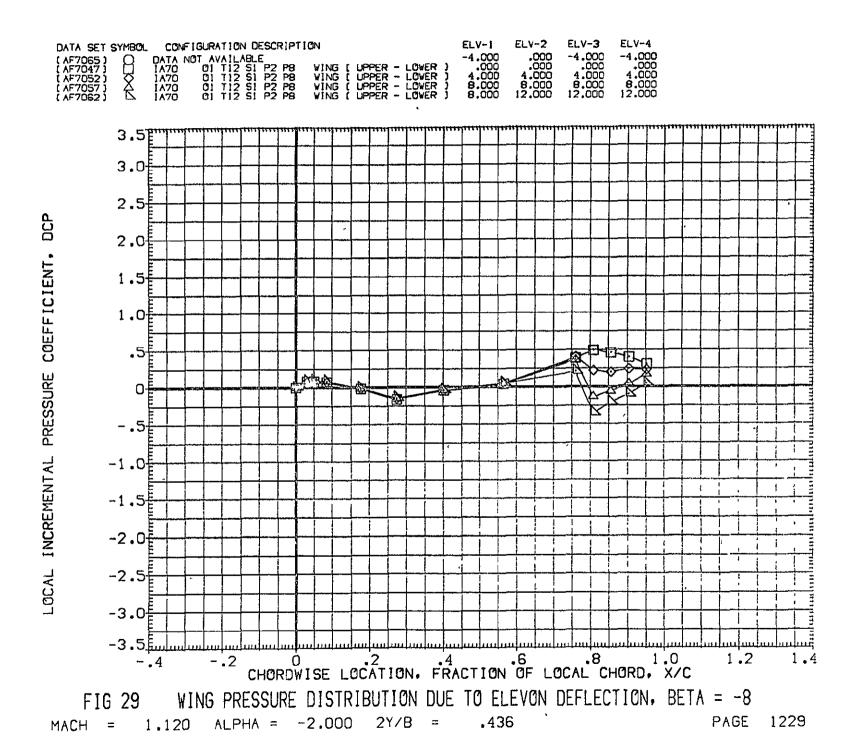


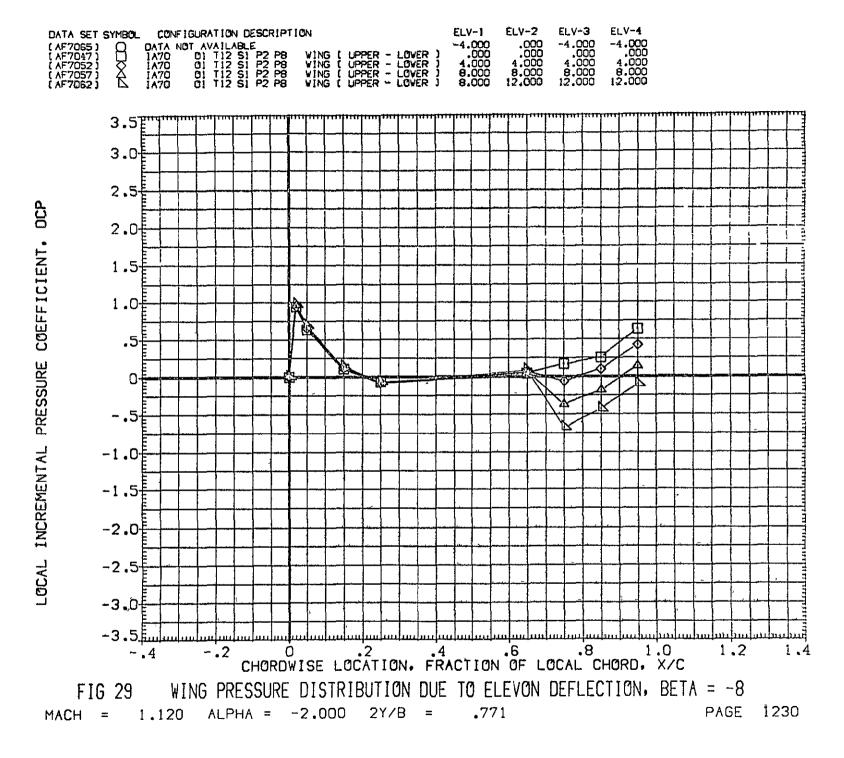
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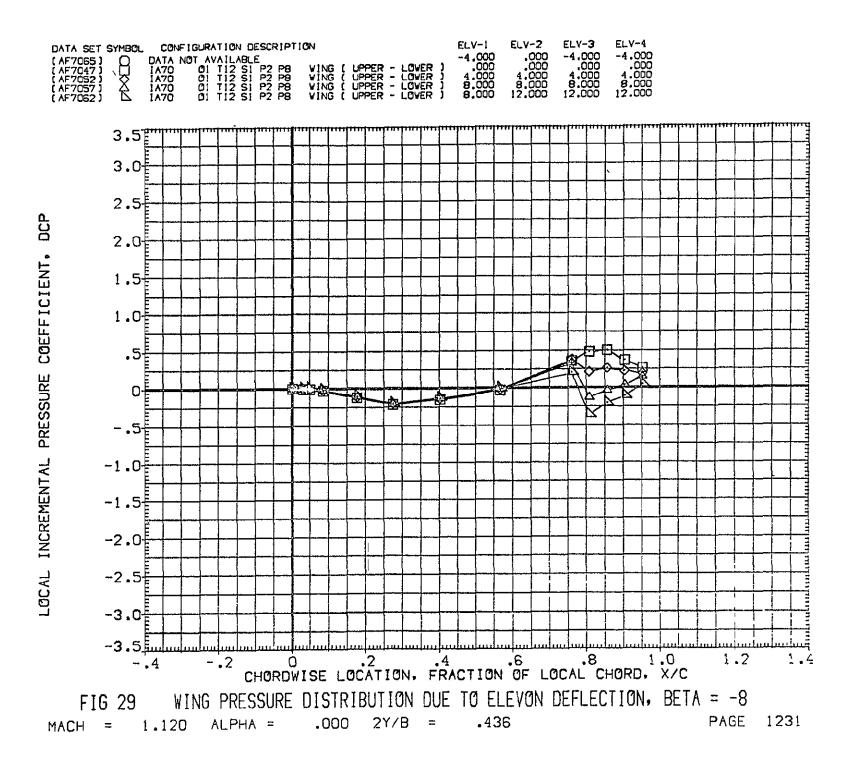


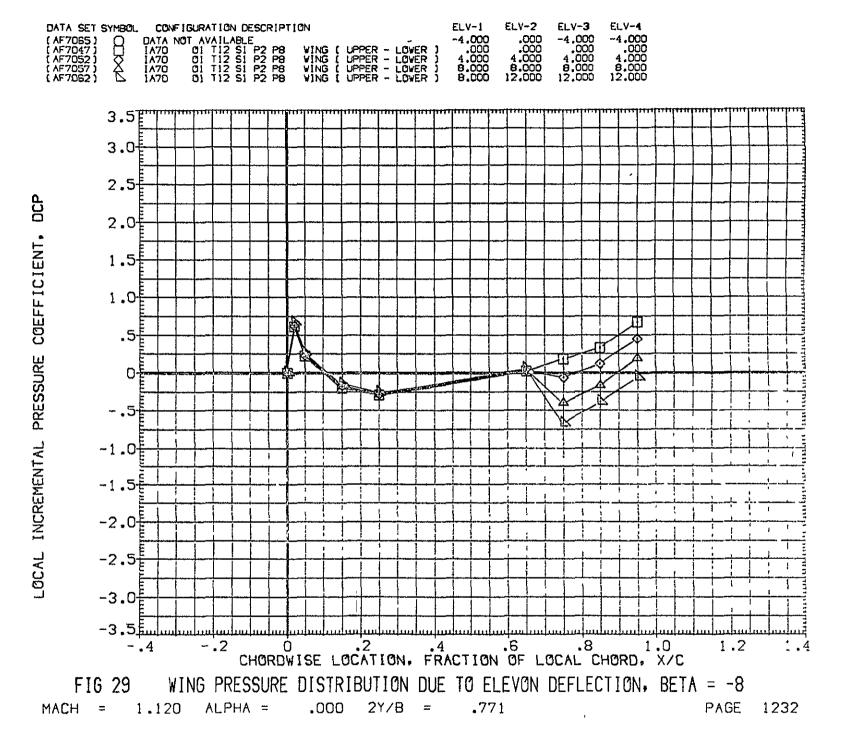


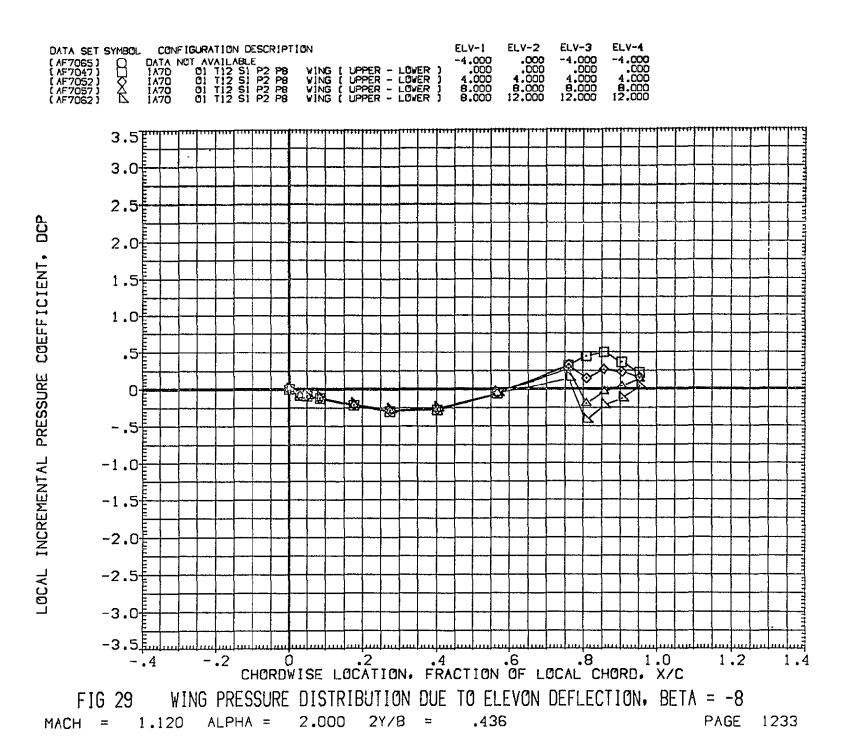
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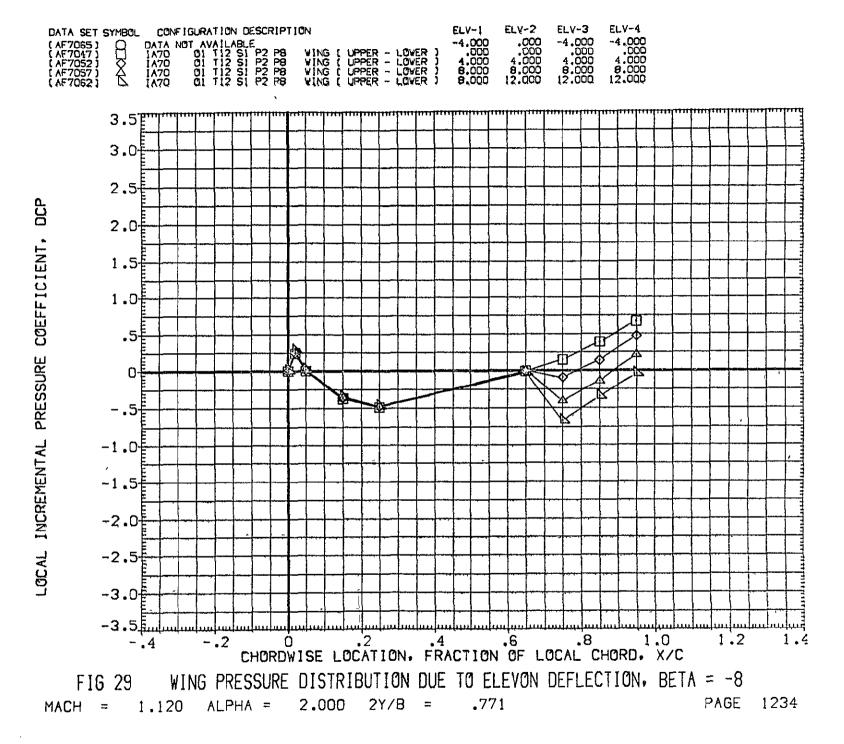


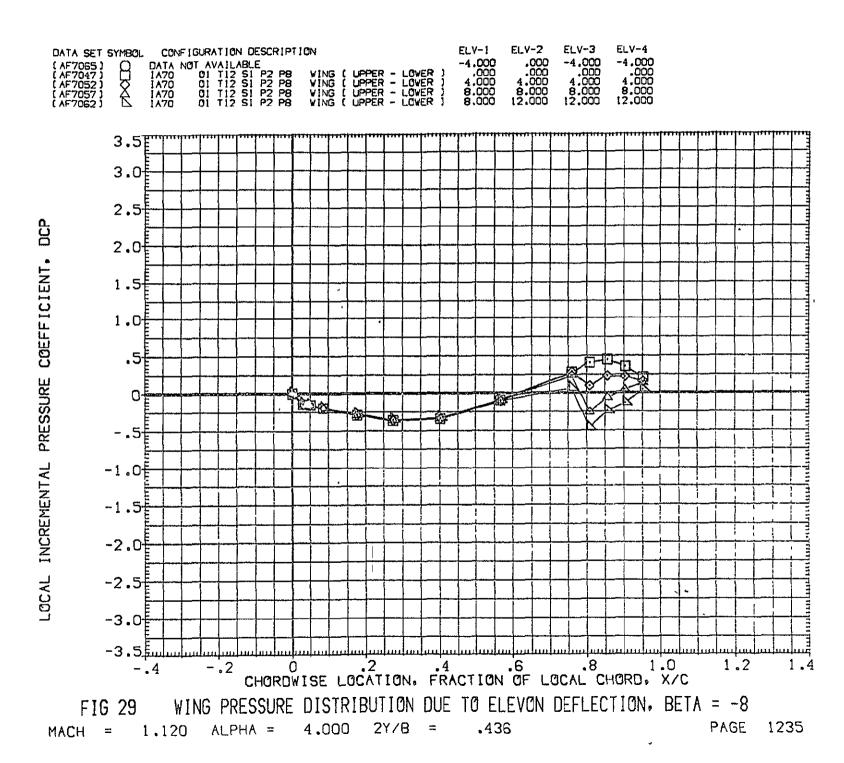




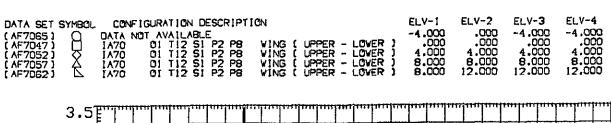












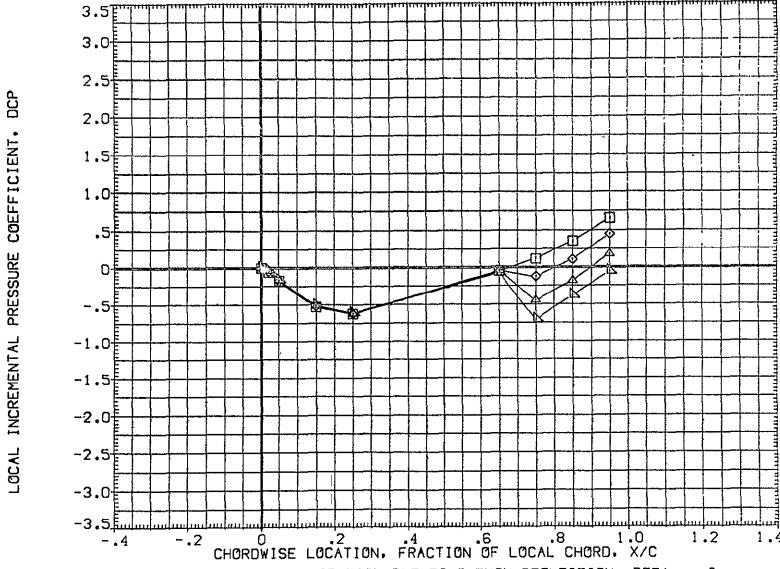
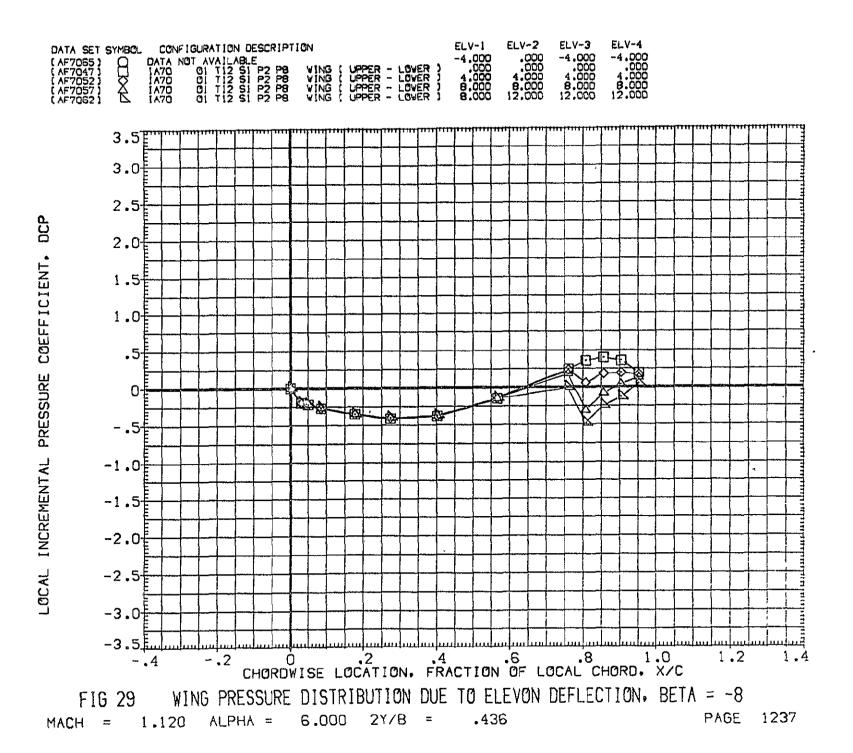
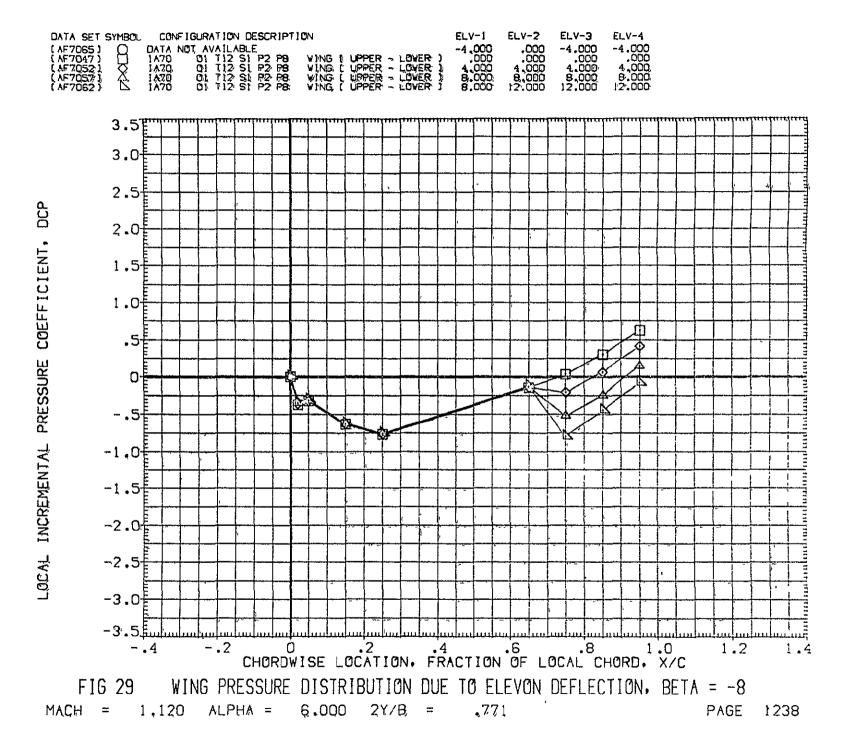
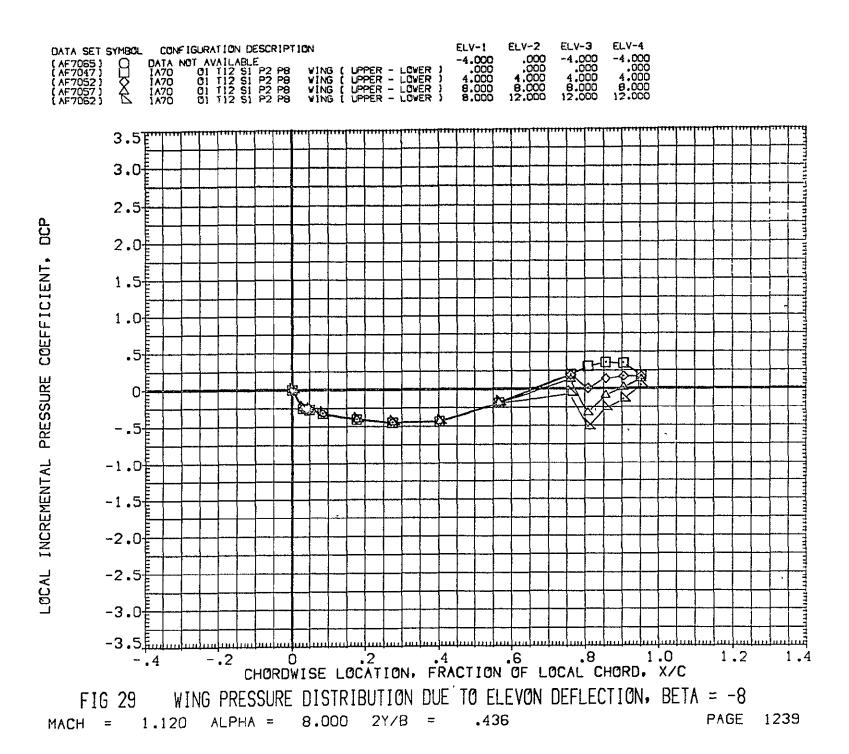


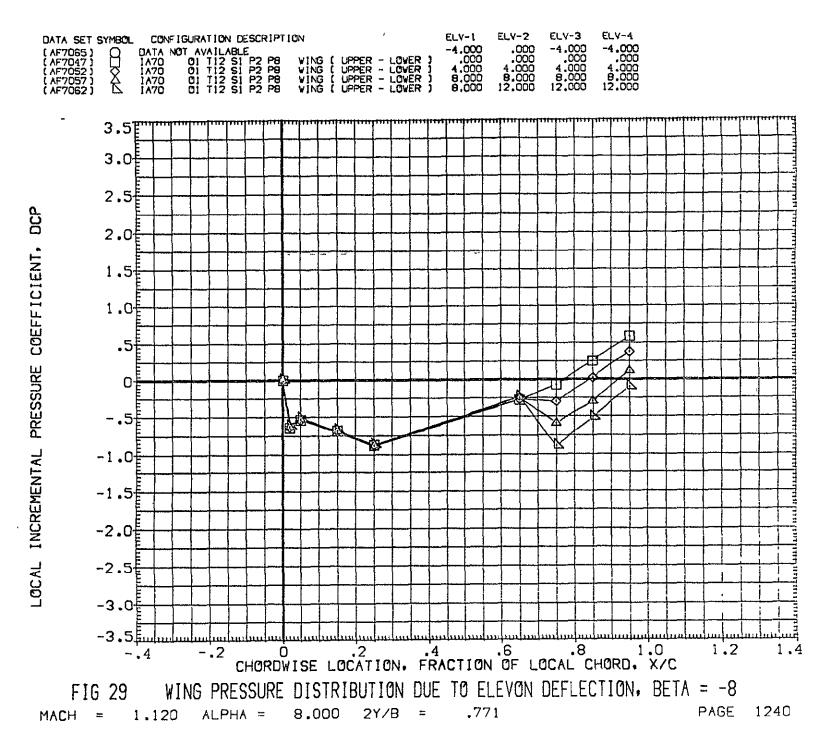
FIG 29 WING PRESSURE DISTRIBUTION DUE TO ELEVON DEFLECTION, BETA = -8

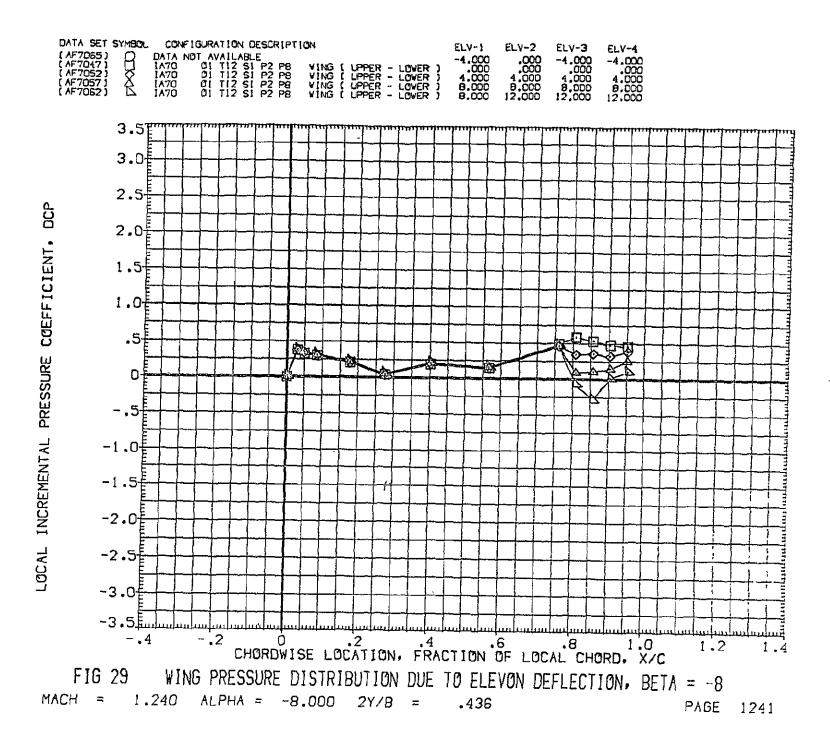
MACH = 1.120 ALPHA = 4.000 2Y/B = .771 PAGE 1236

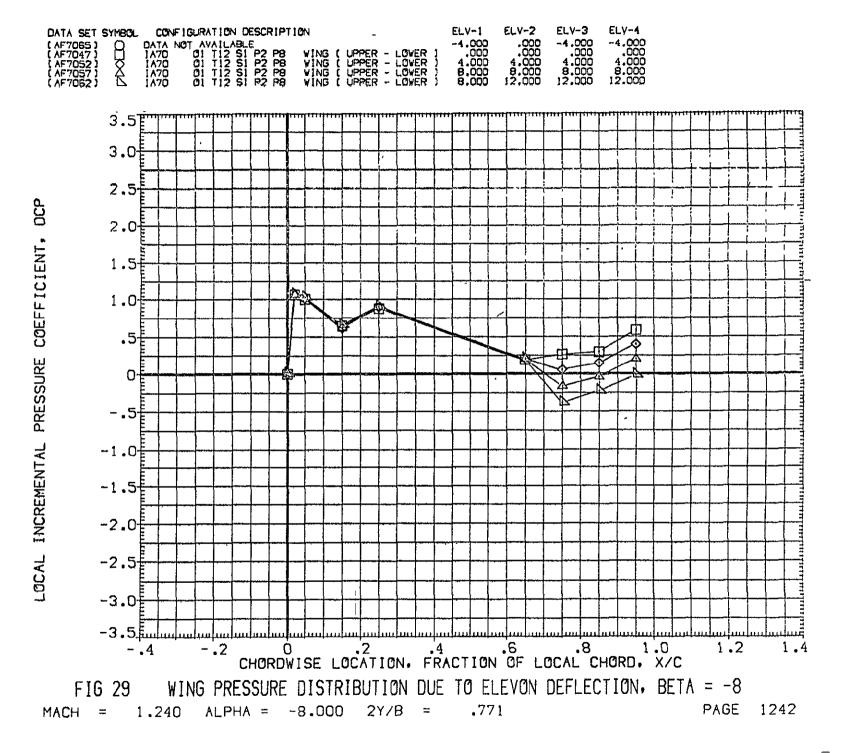


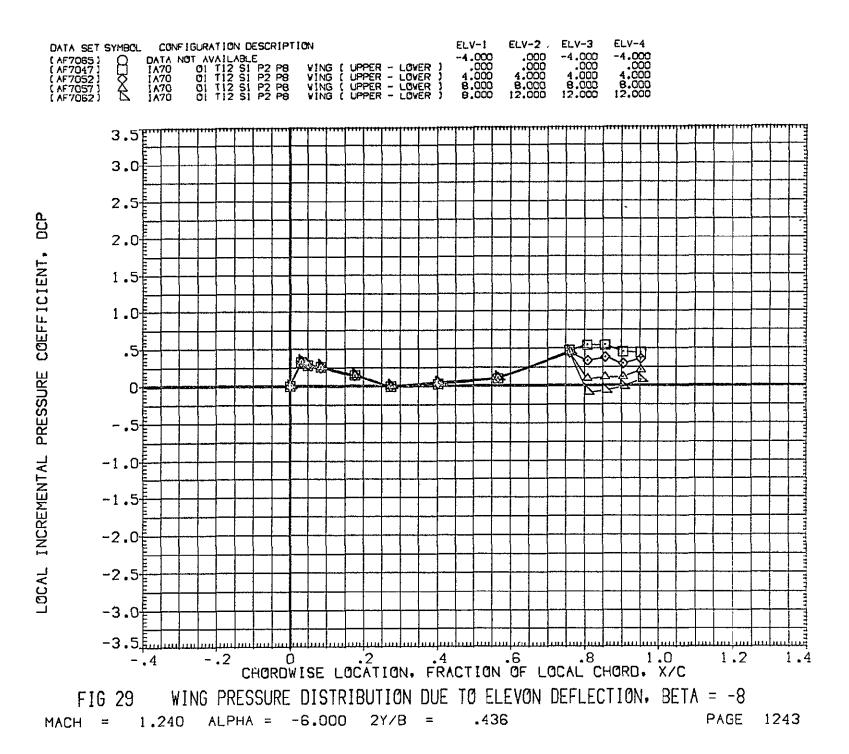


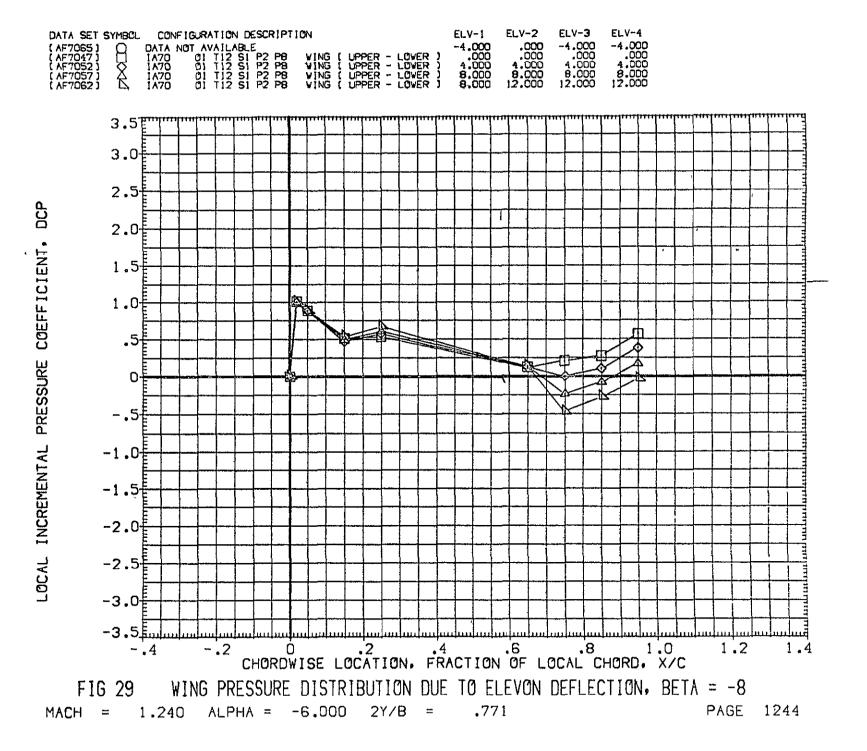


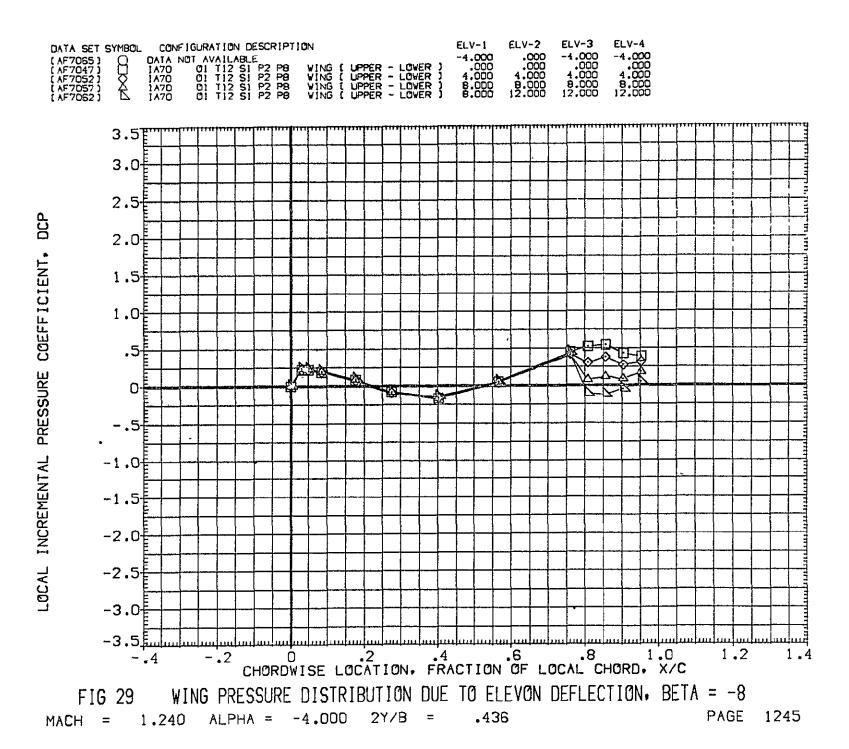


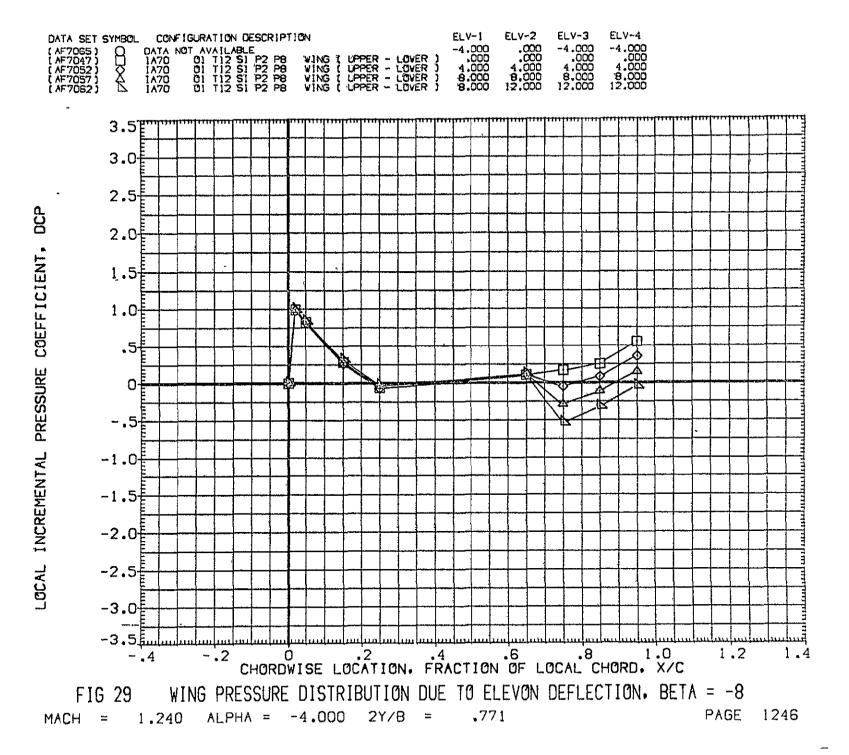


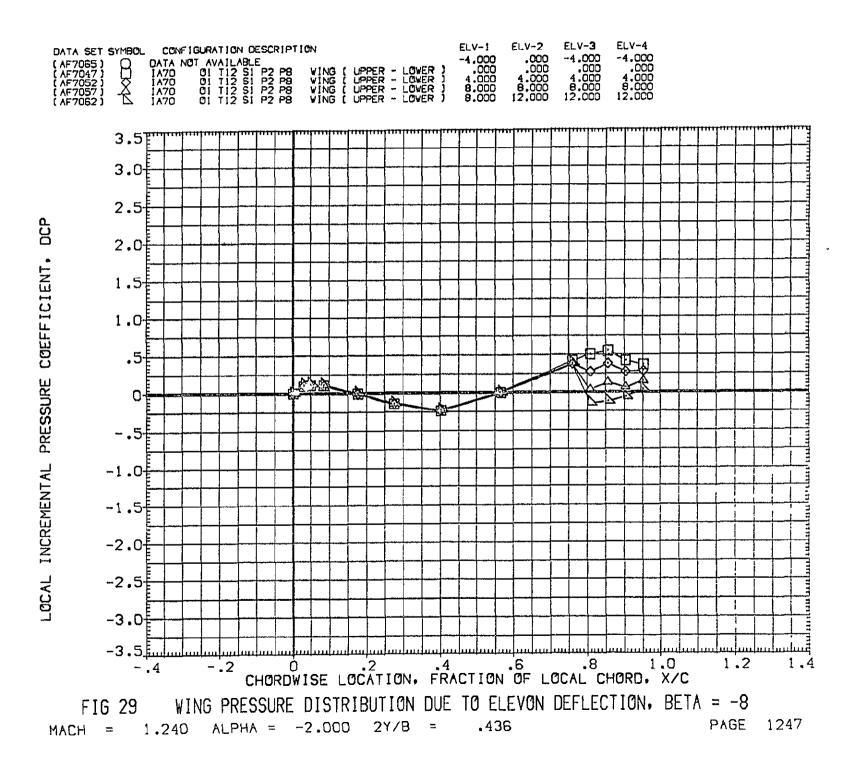


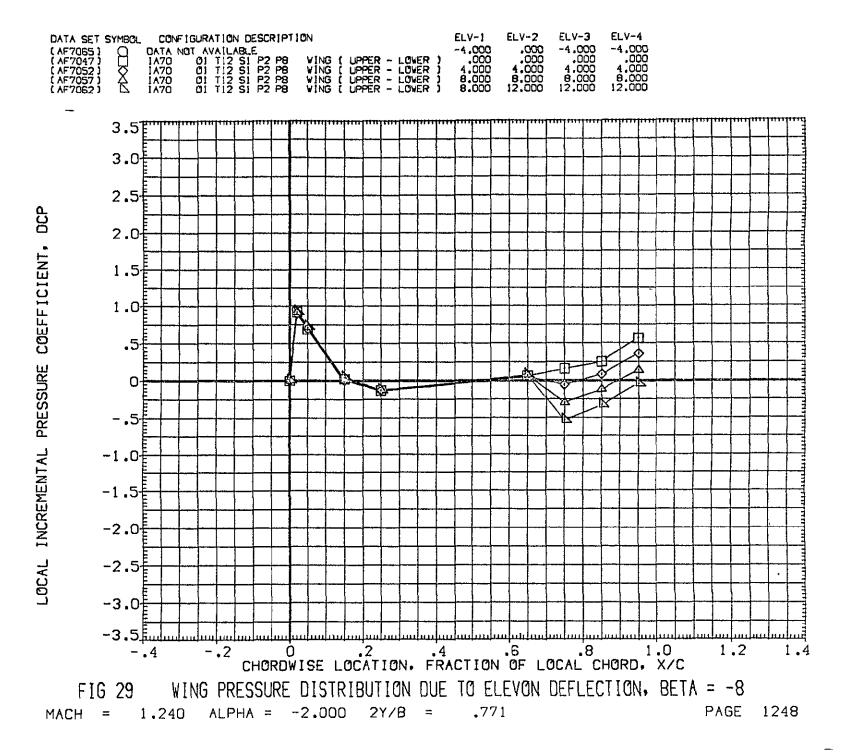


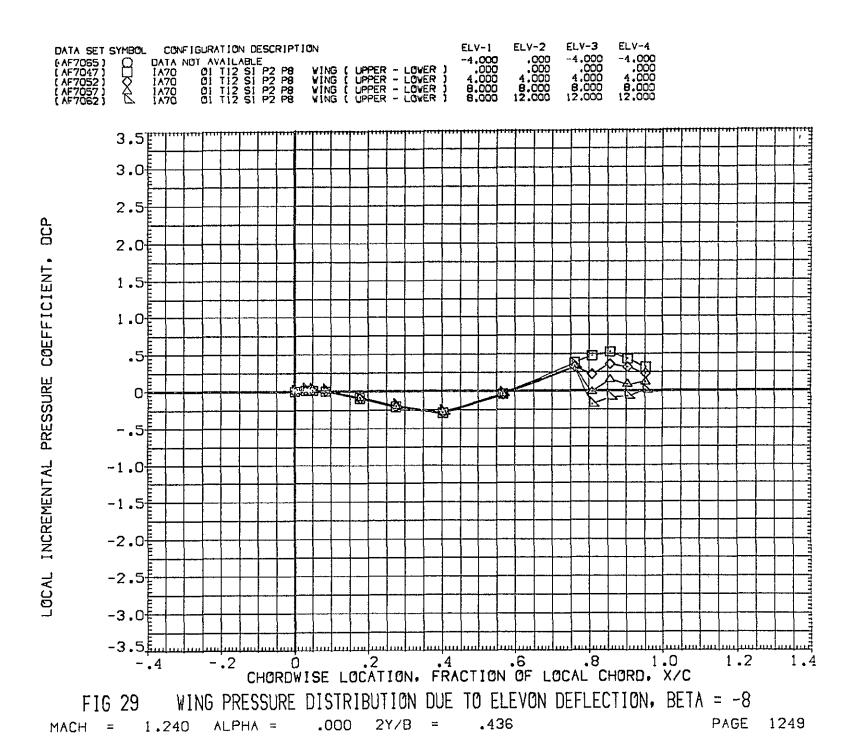


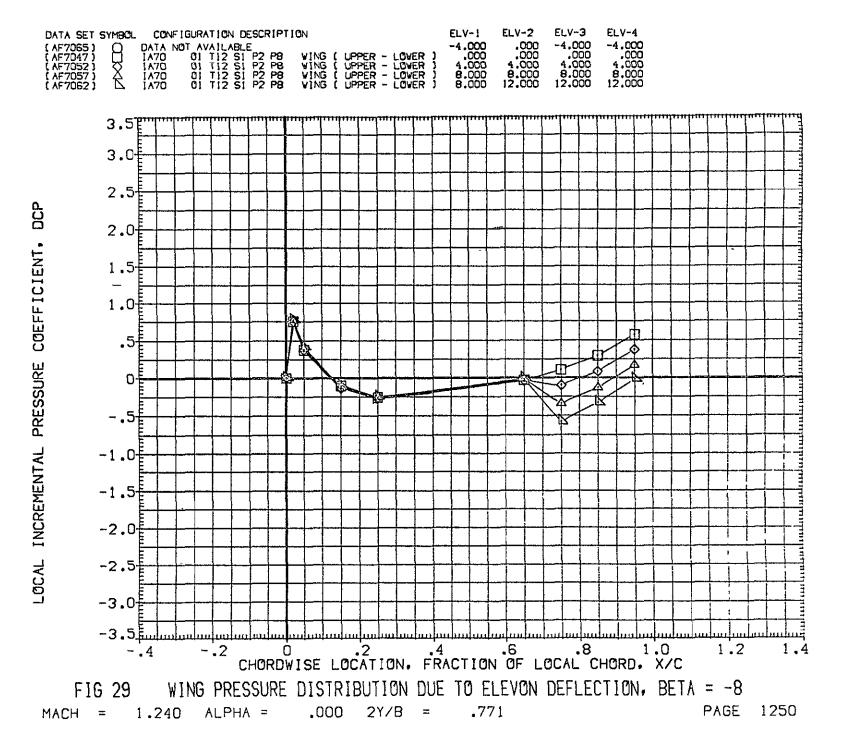


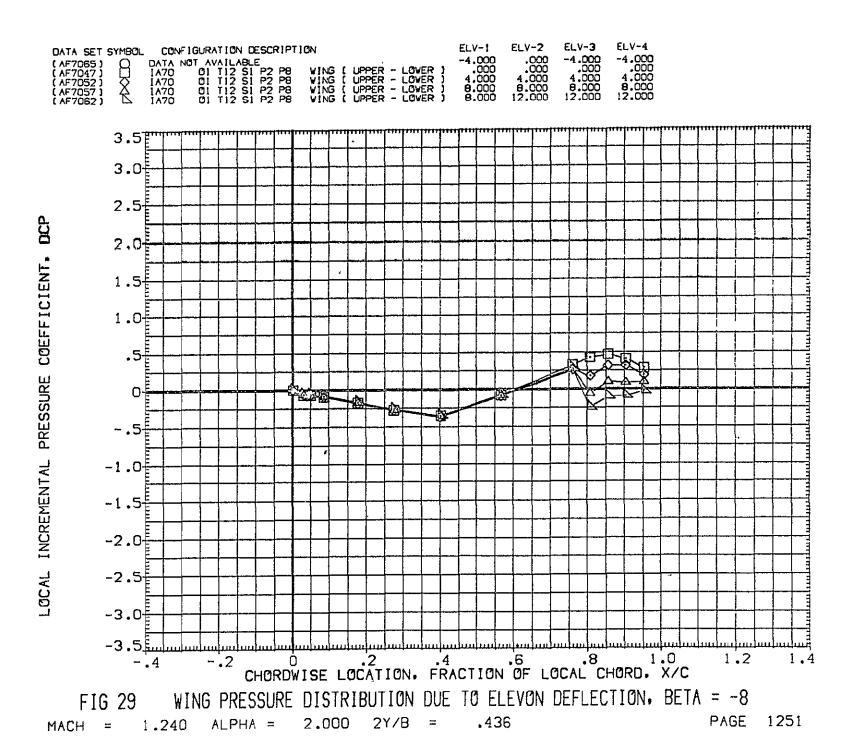


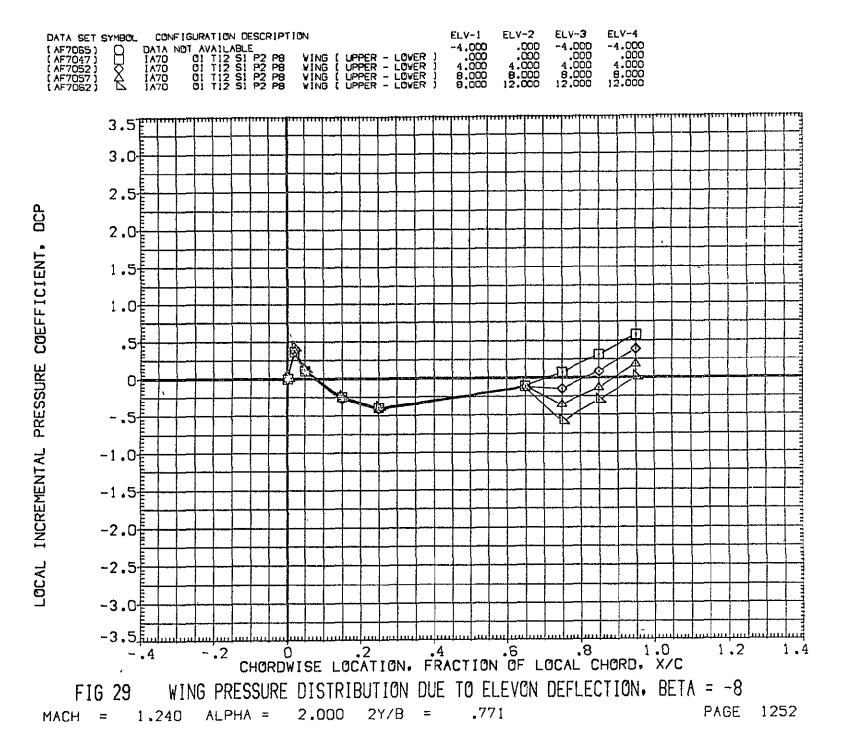


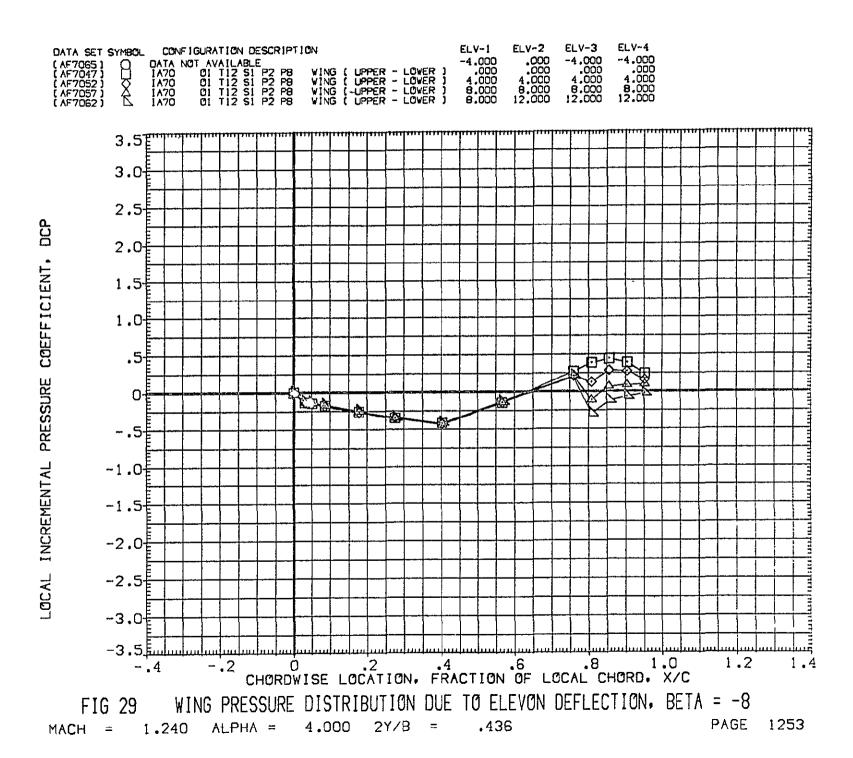


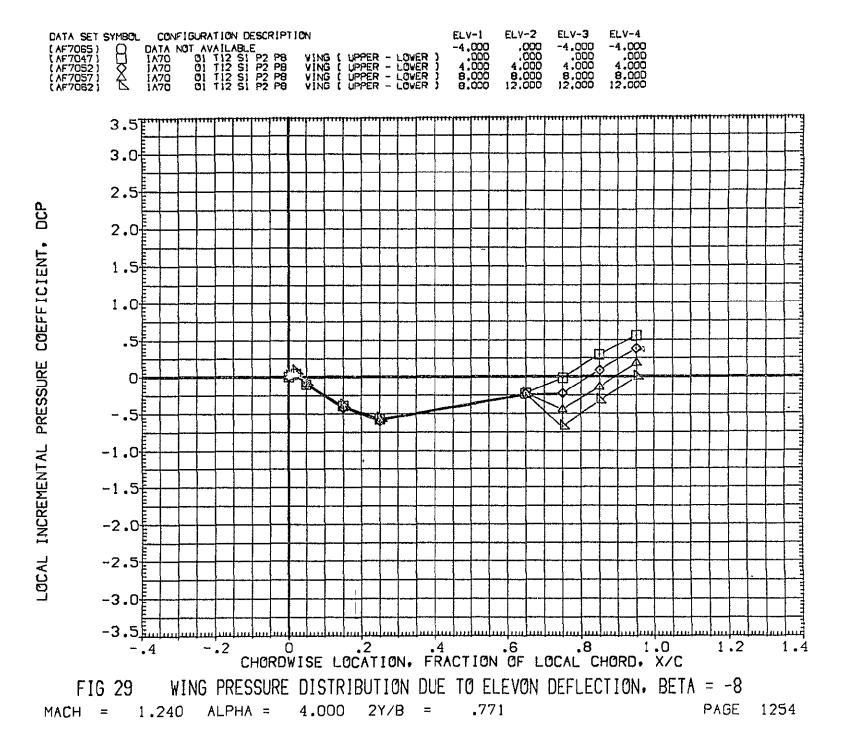


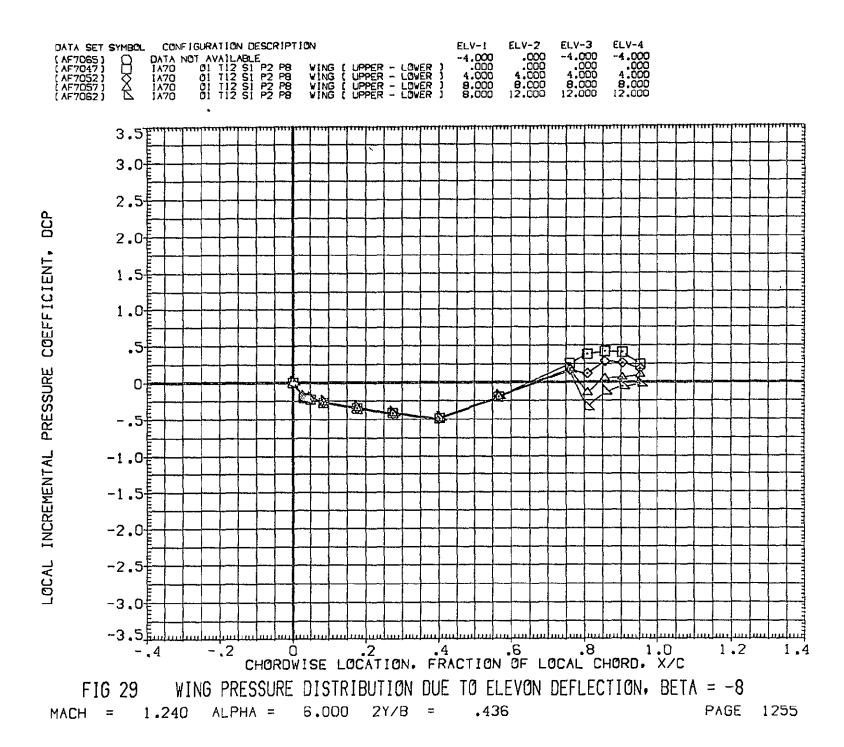


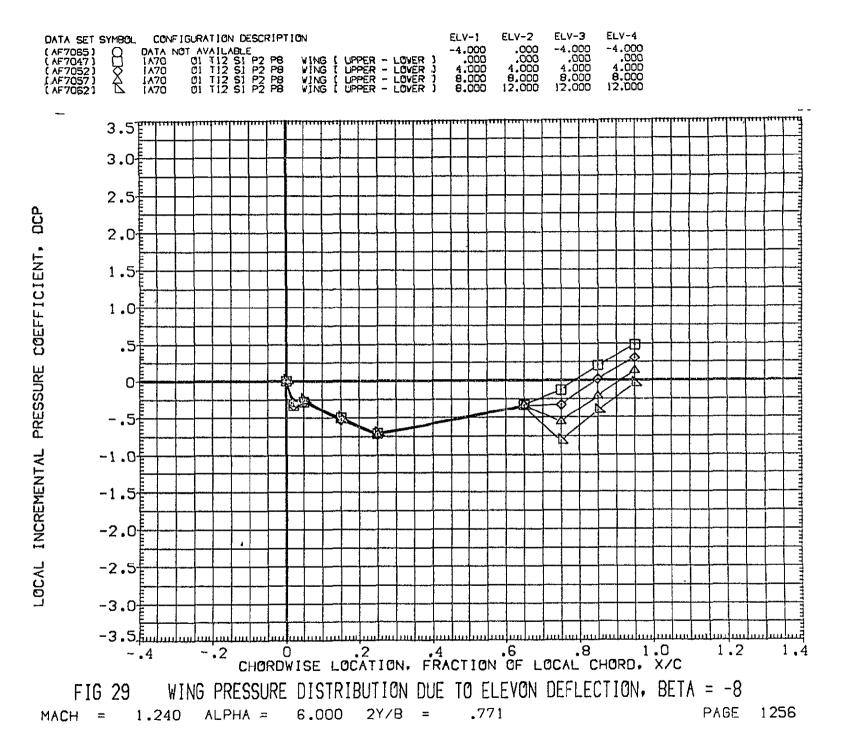


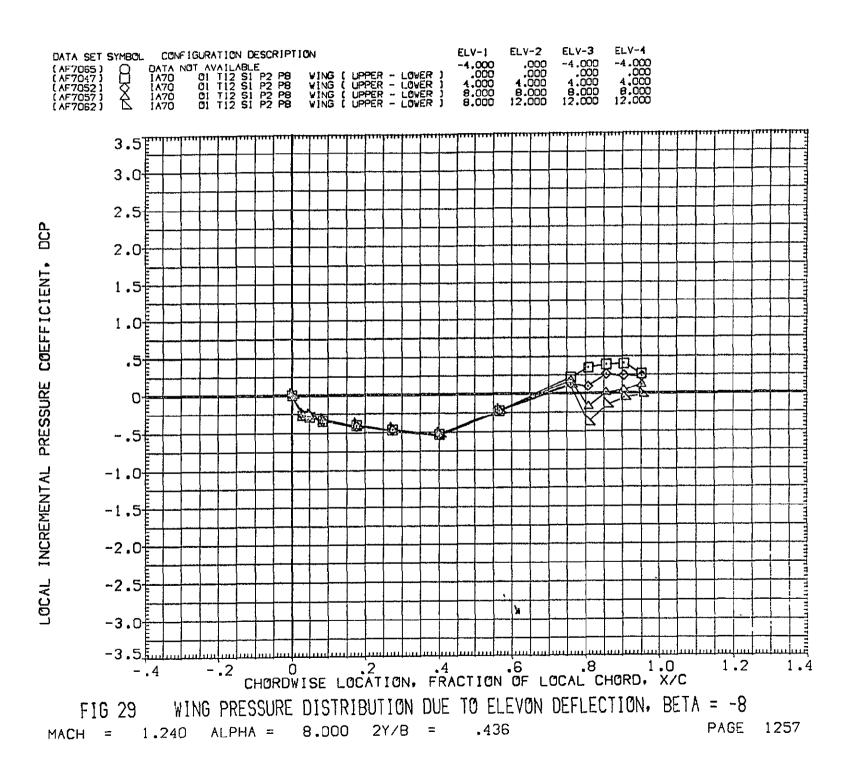


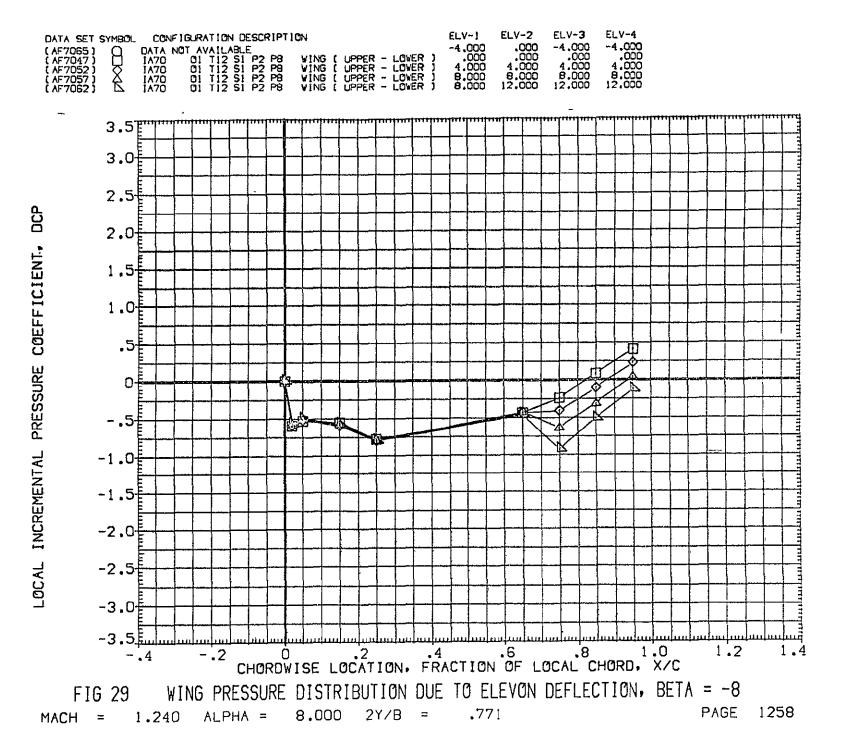


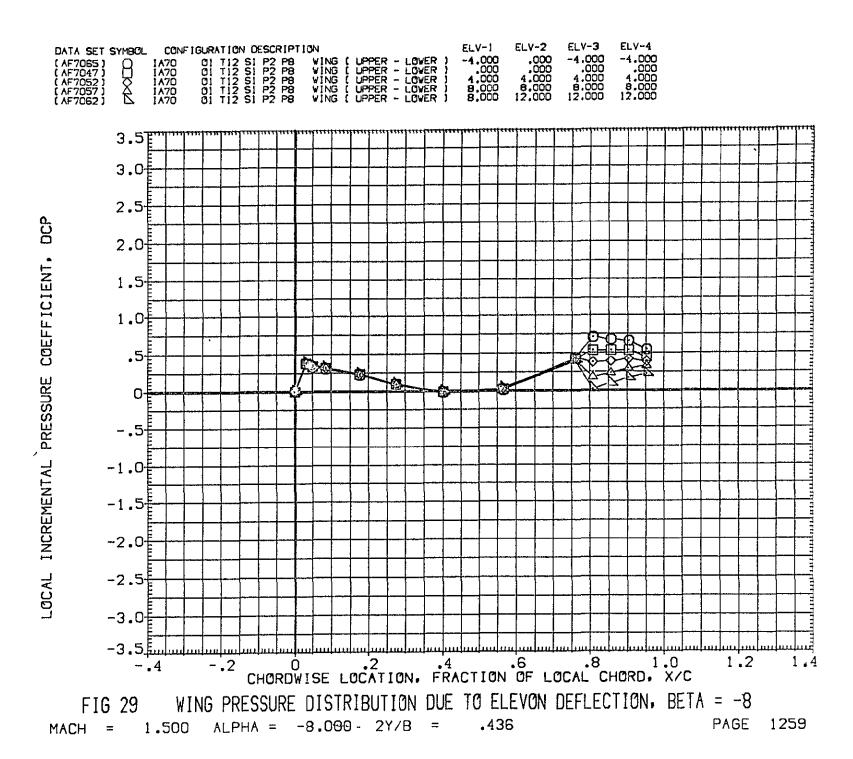


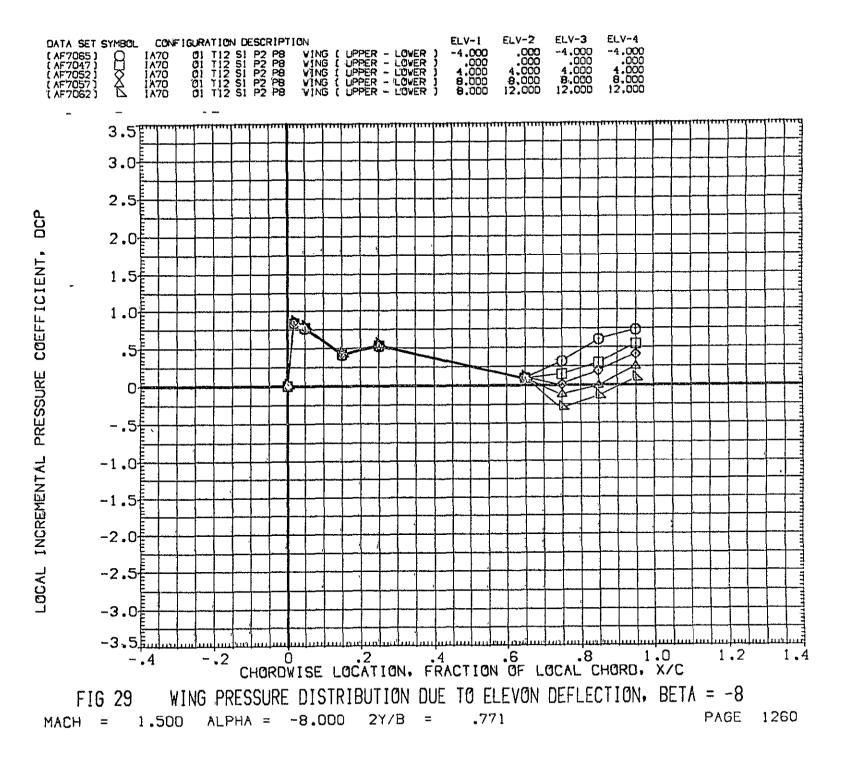


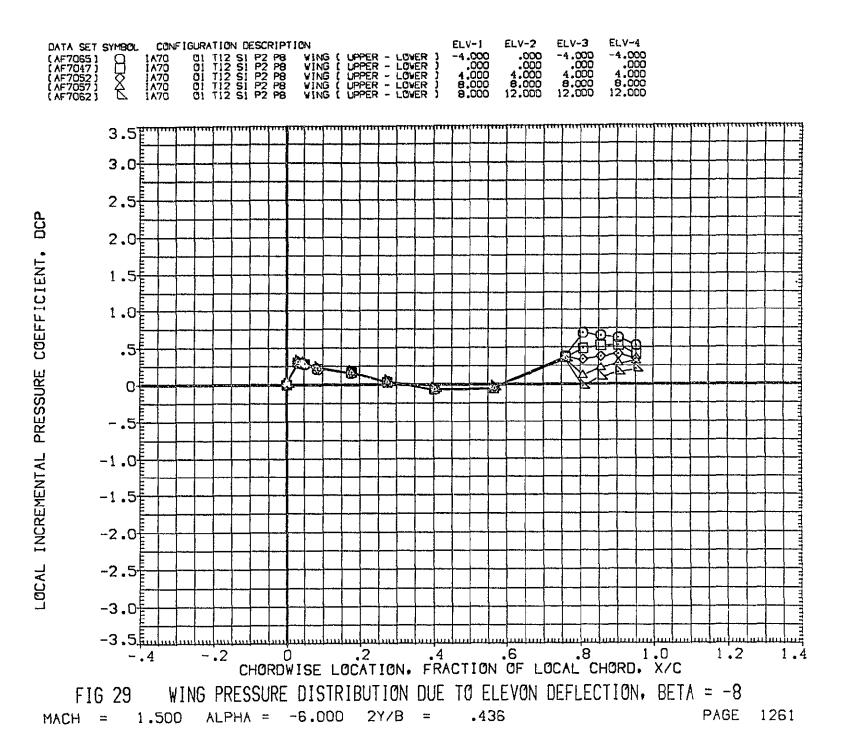


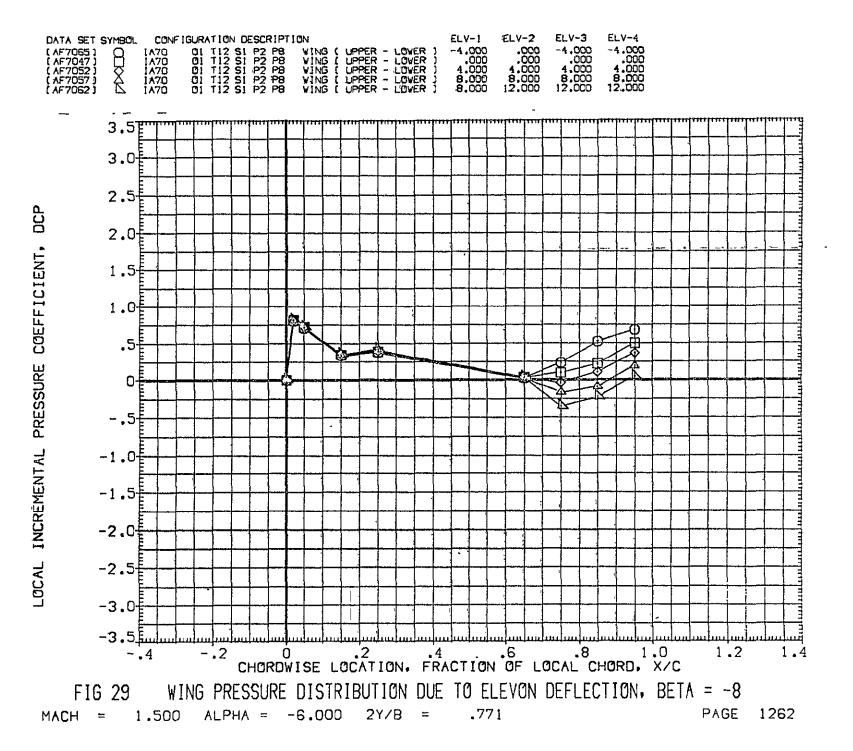


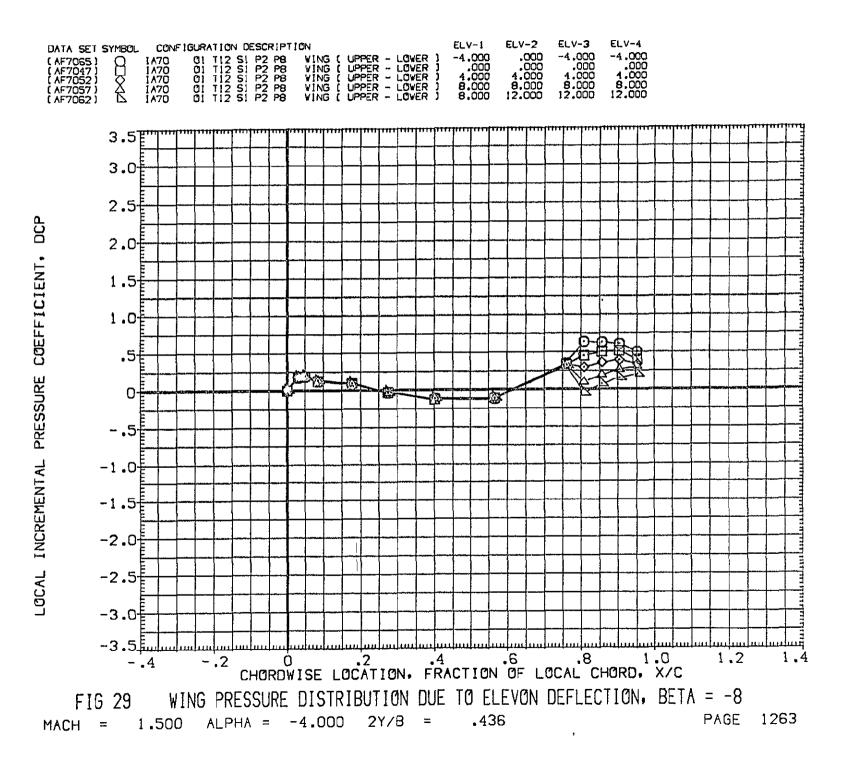


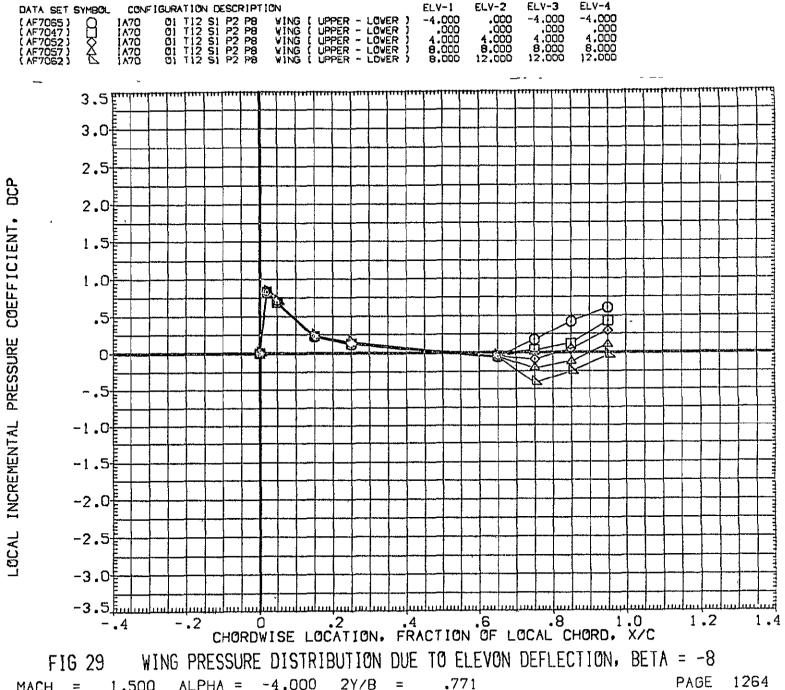




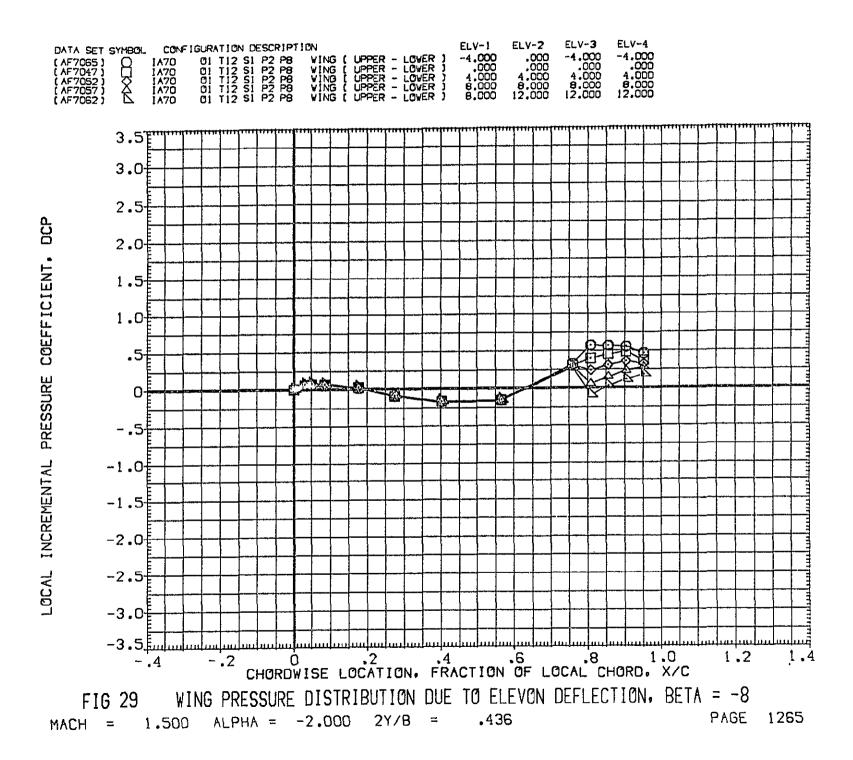


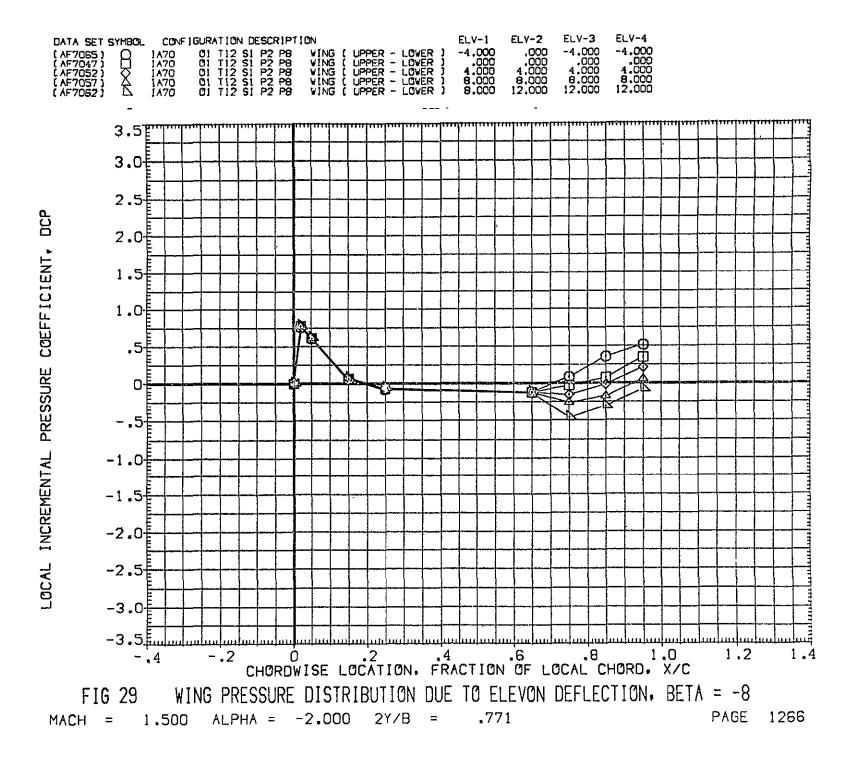


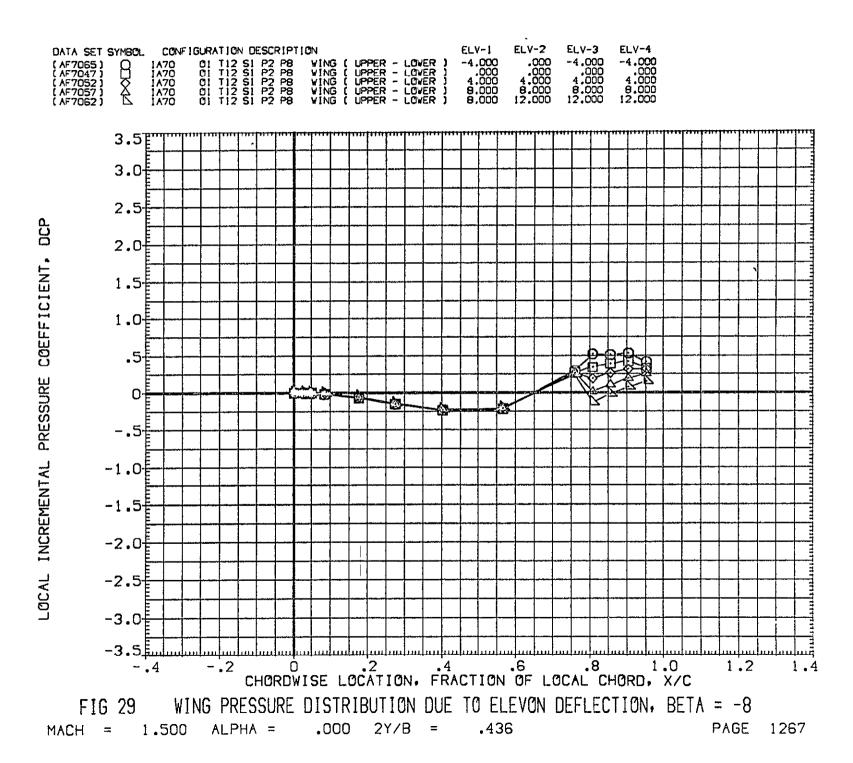


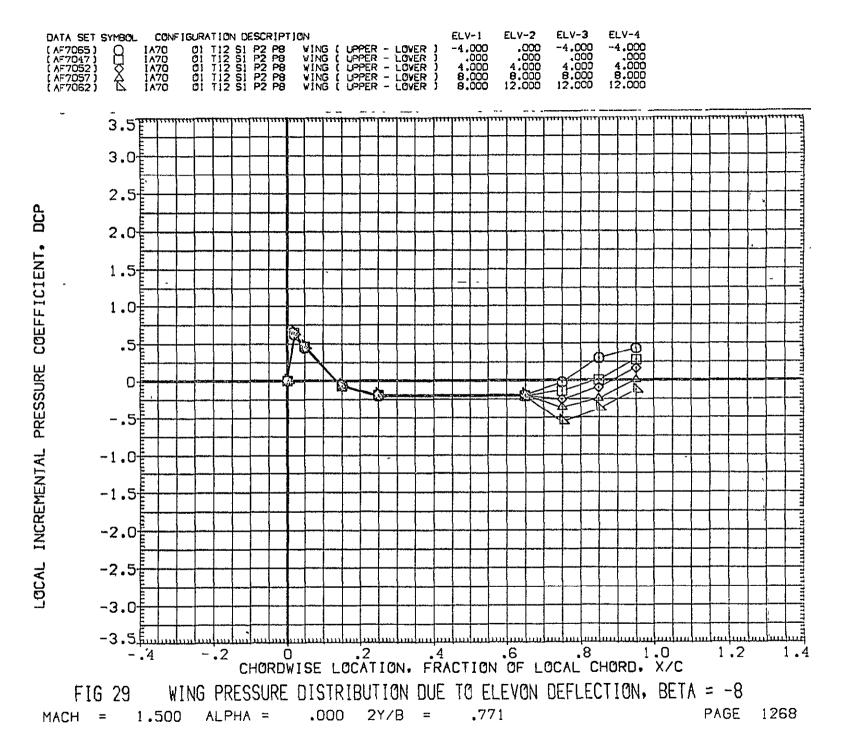


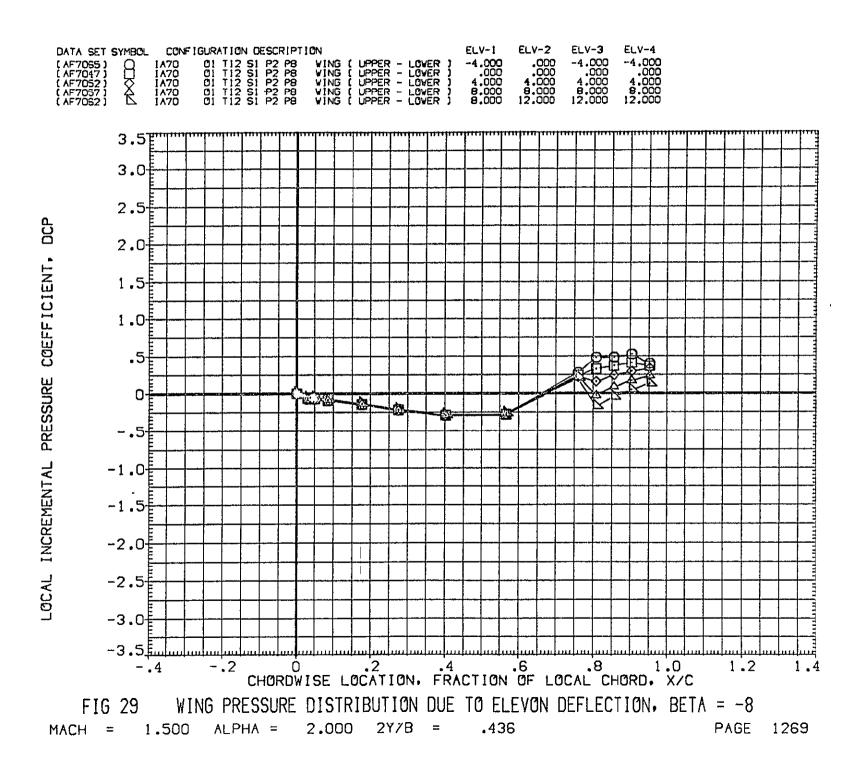
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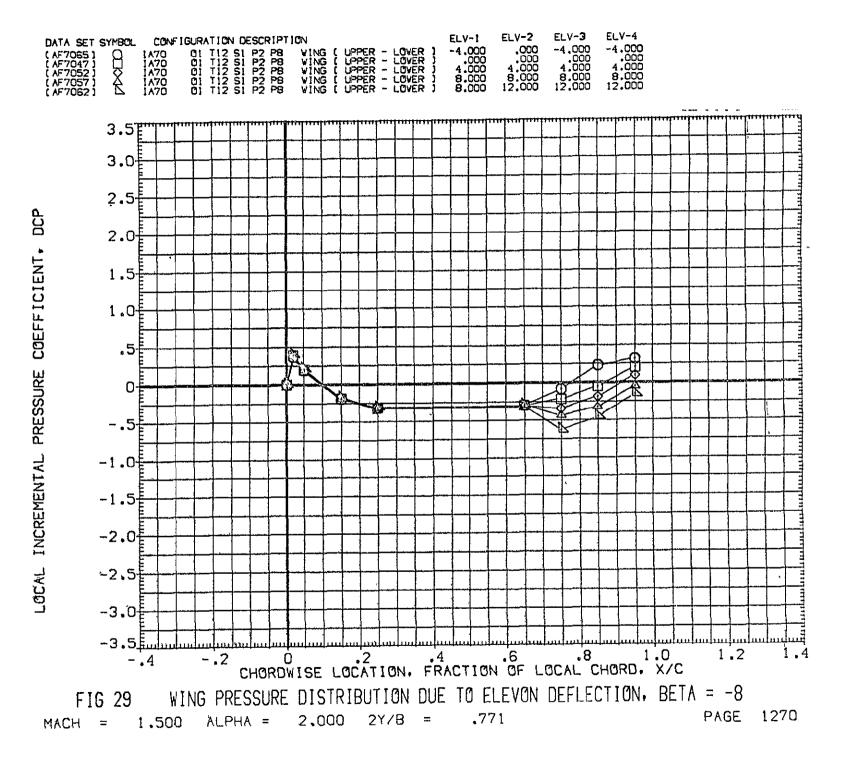


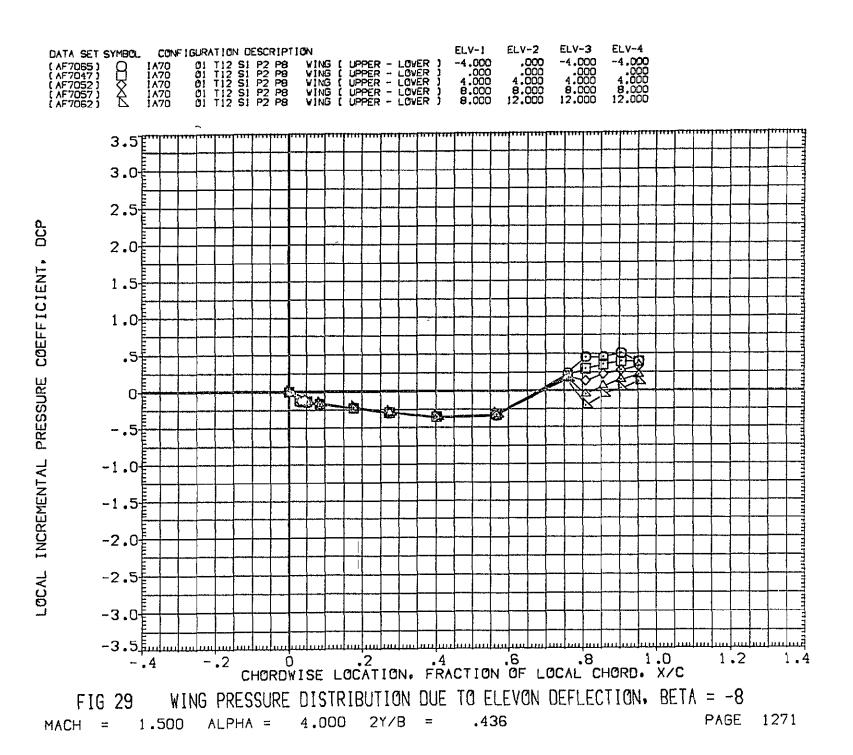


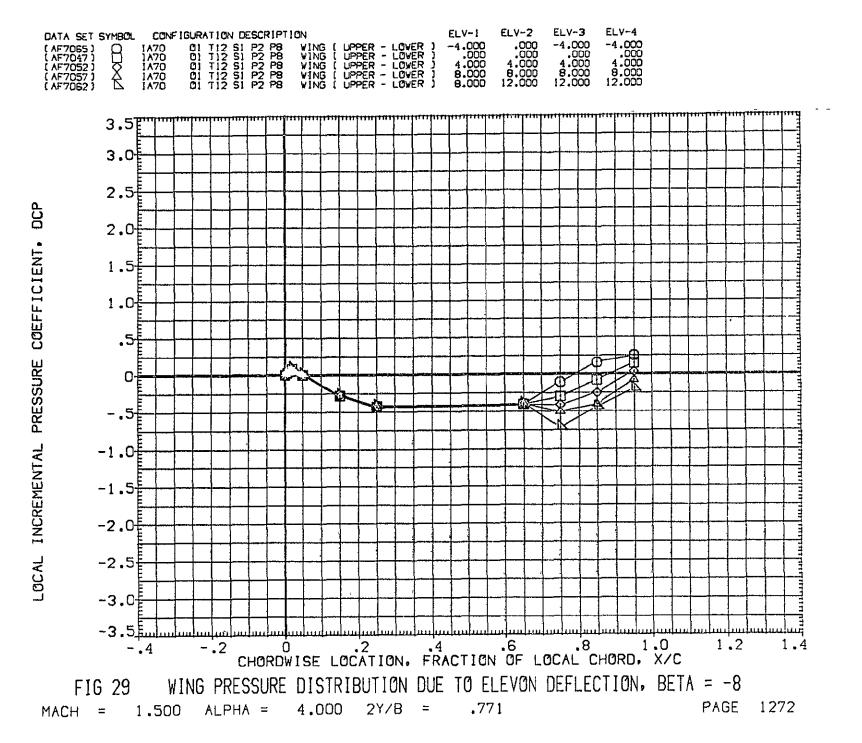


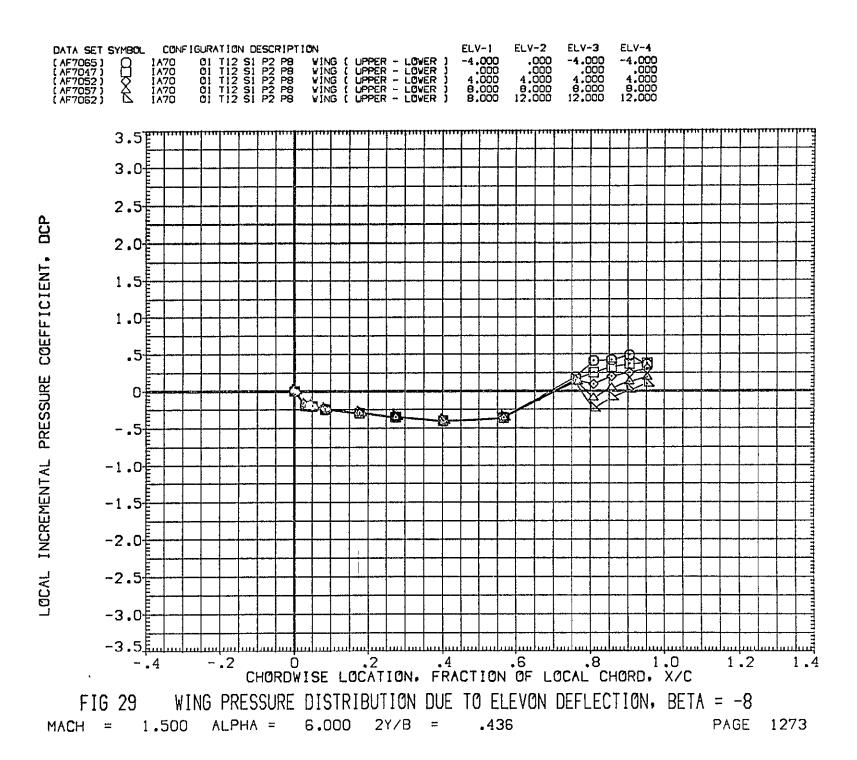


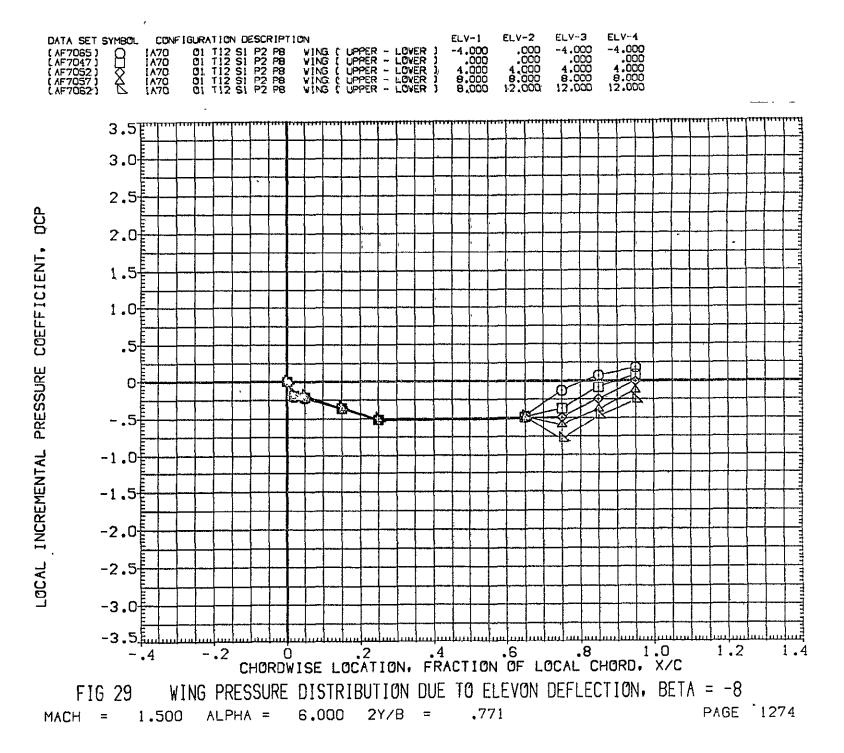


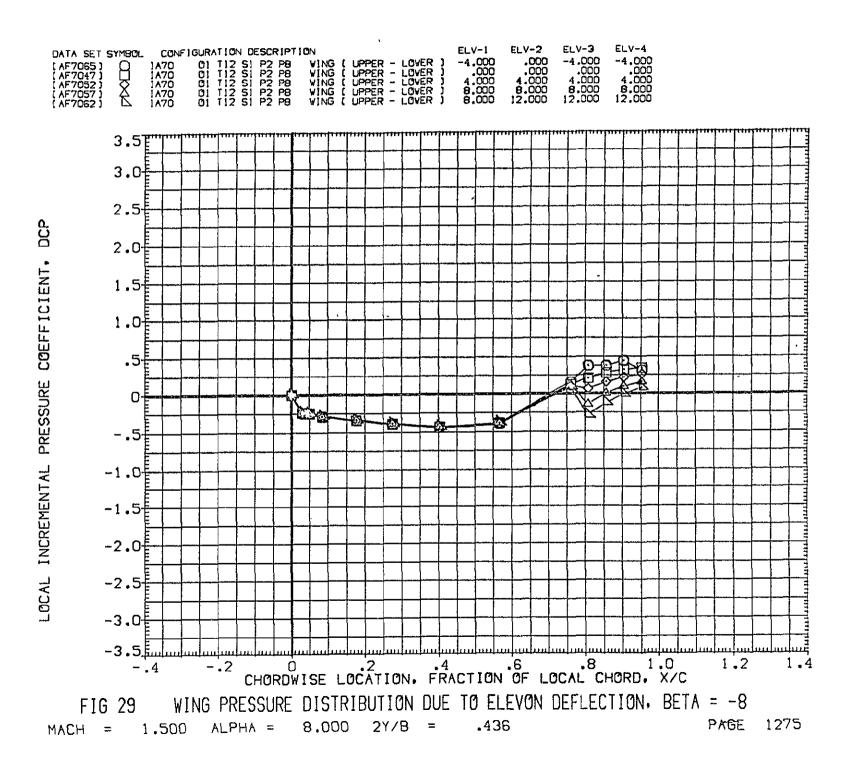


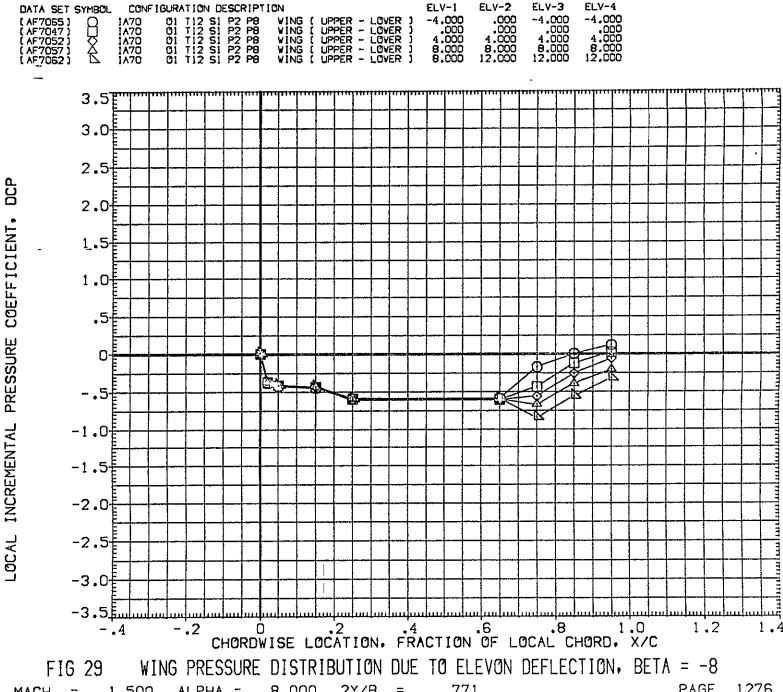




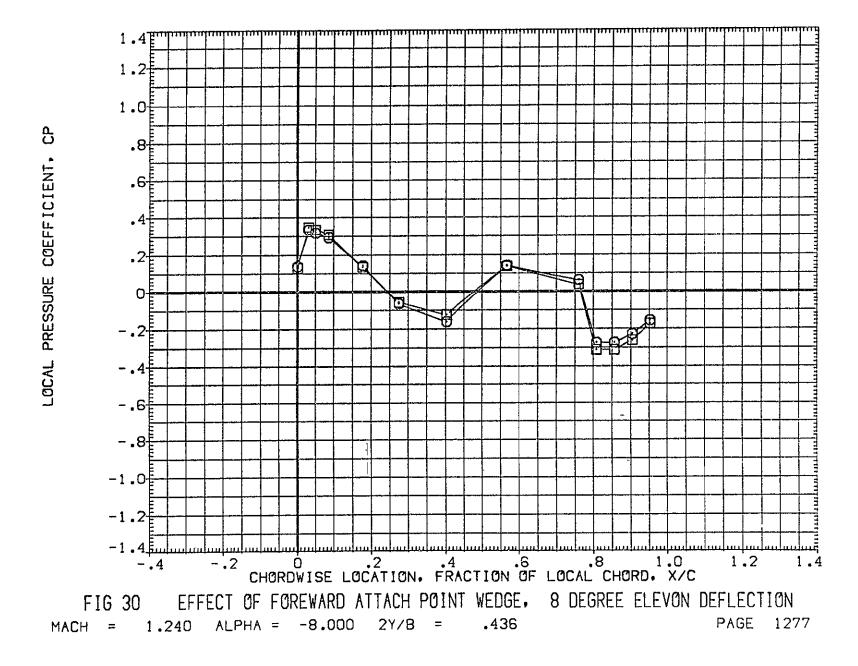


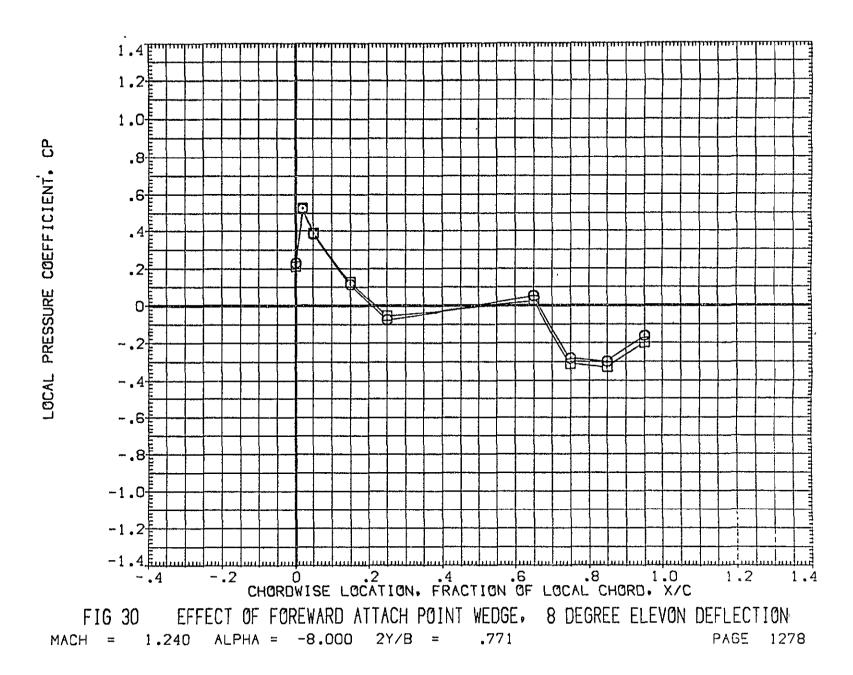






PAGE 1276 MACH = 1.500 ALPHA = 8.0002Y/B = .771

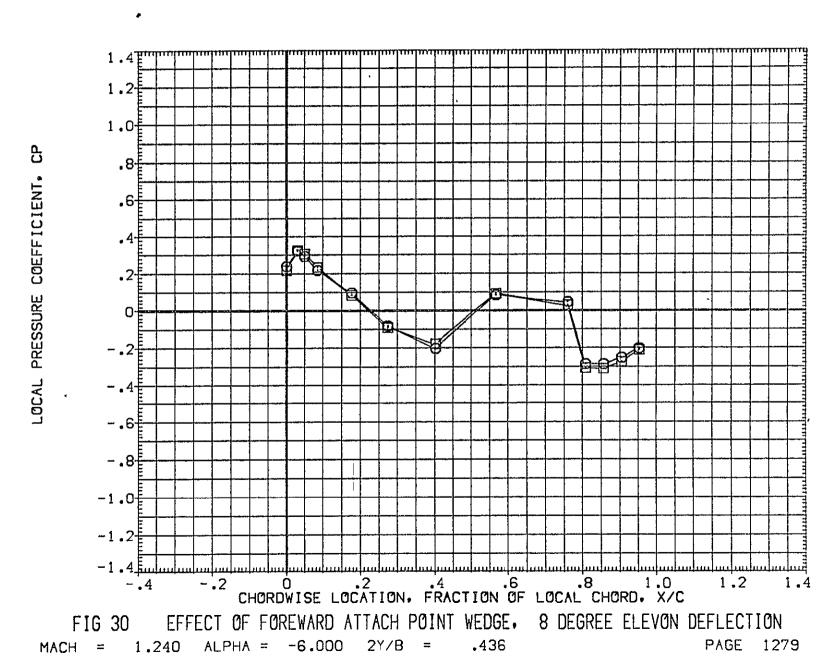


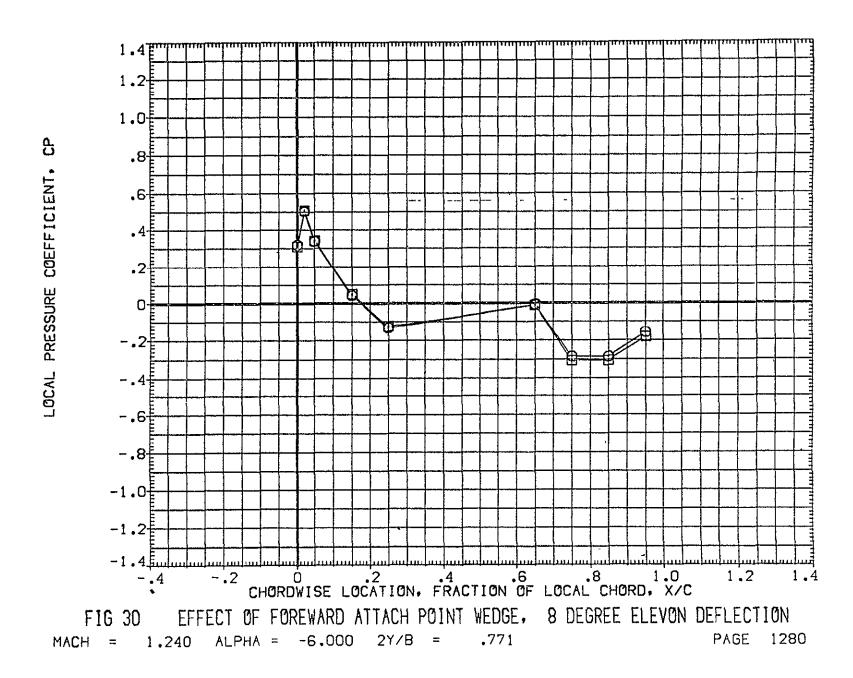


ELV-3

ELV-4



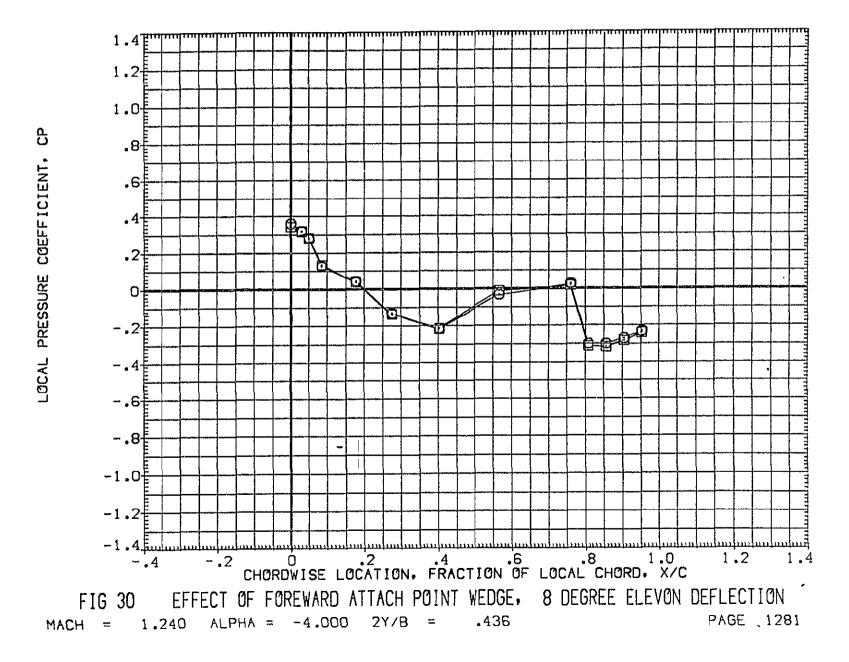


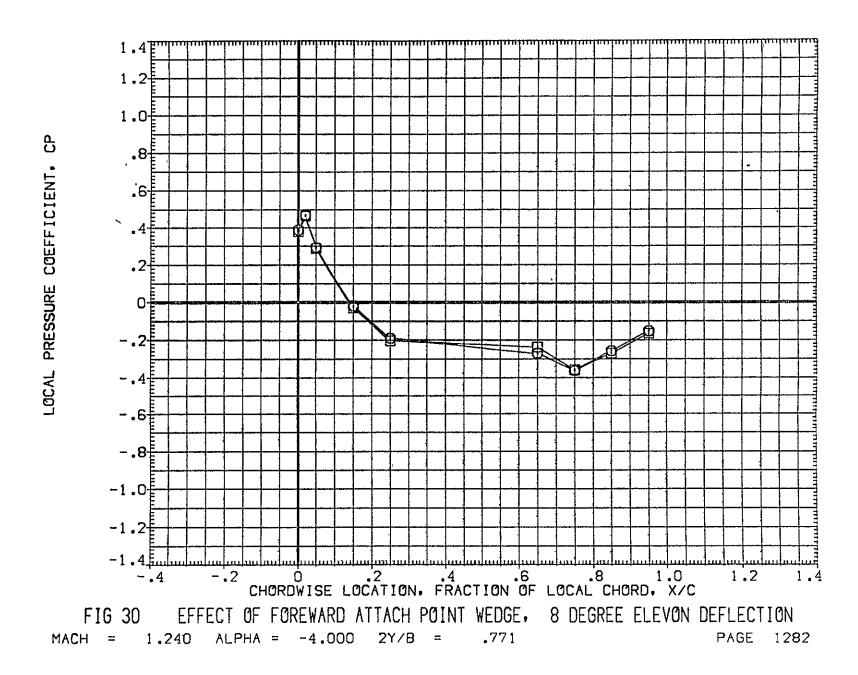


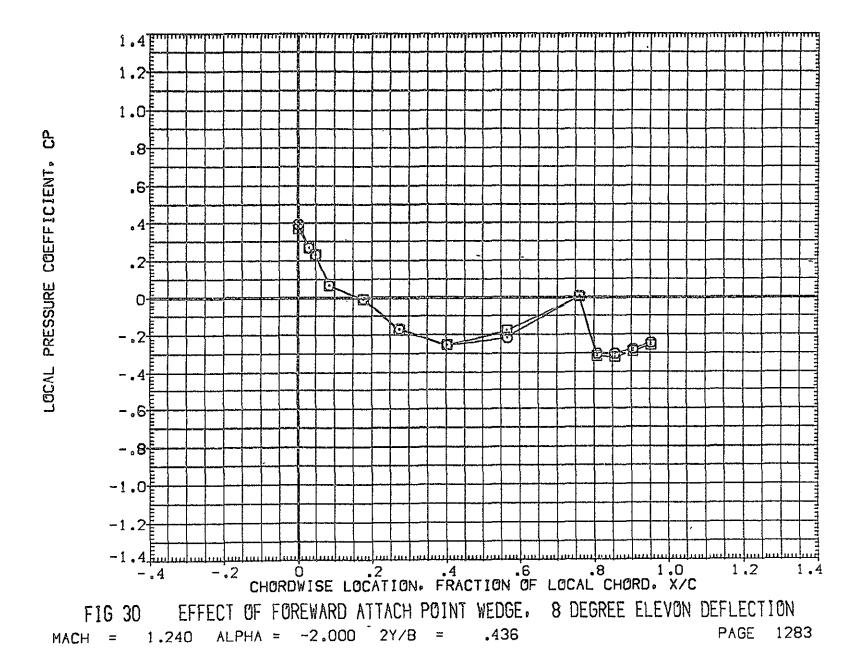
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 ELV-2
 ELV-3
 ELV-4

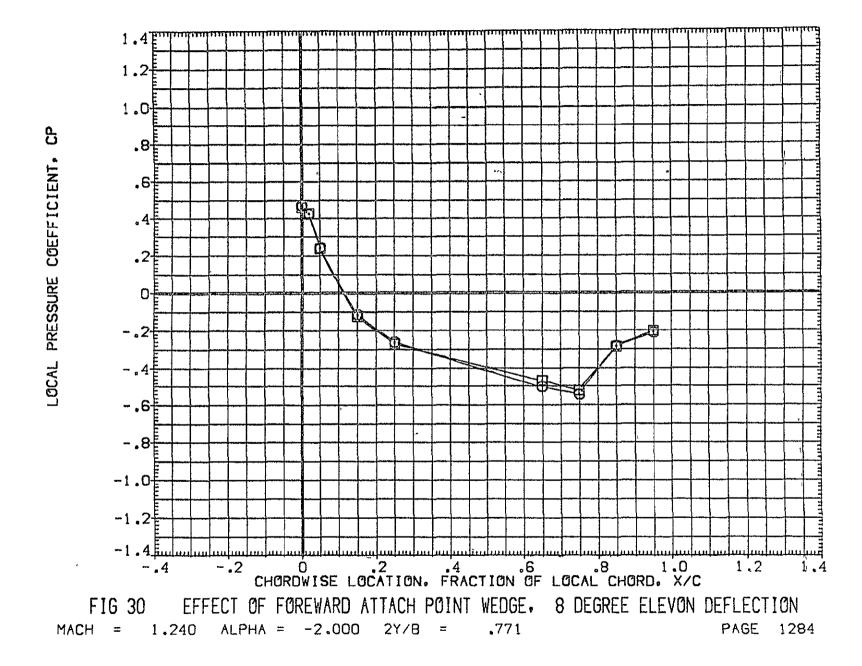
 WING UPPER SURFACE
 8.000
 8.000
 8.000
 8.000

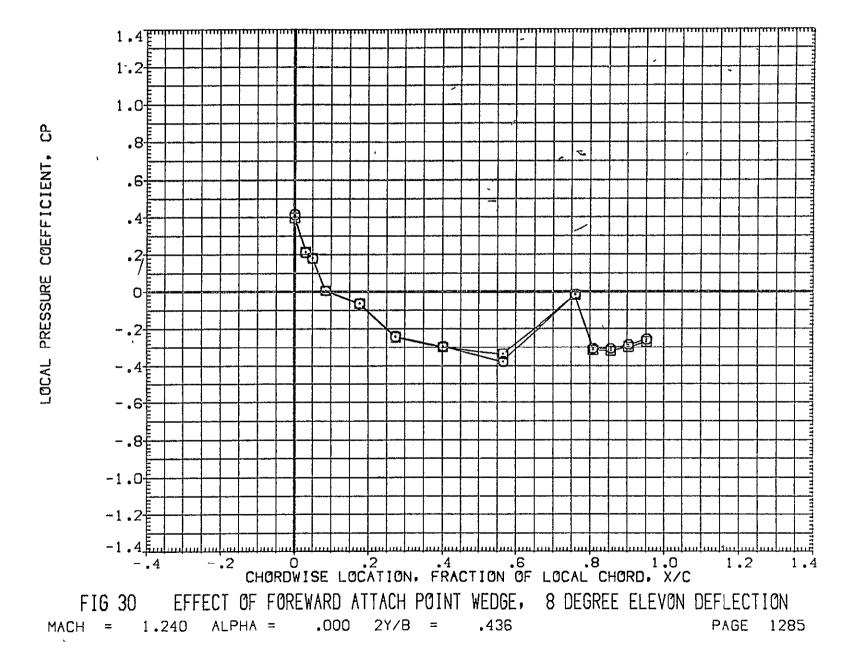
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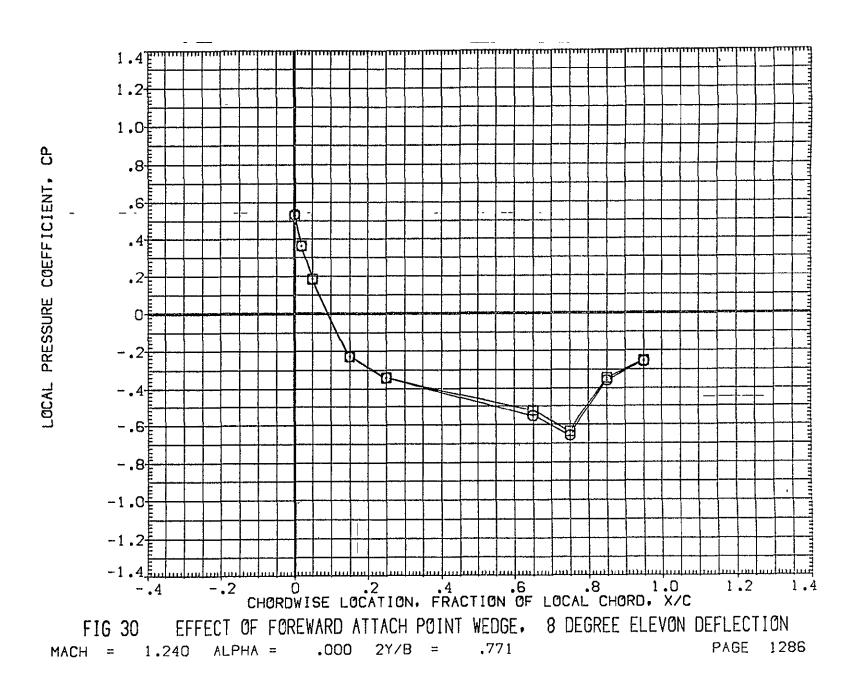


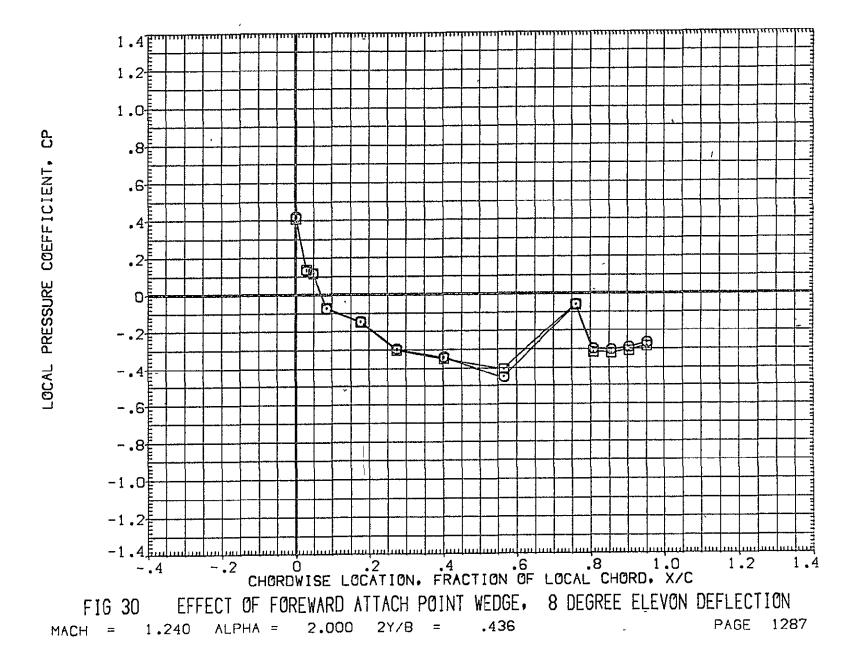


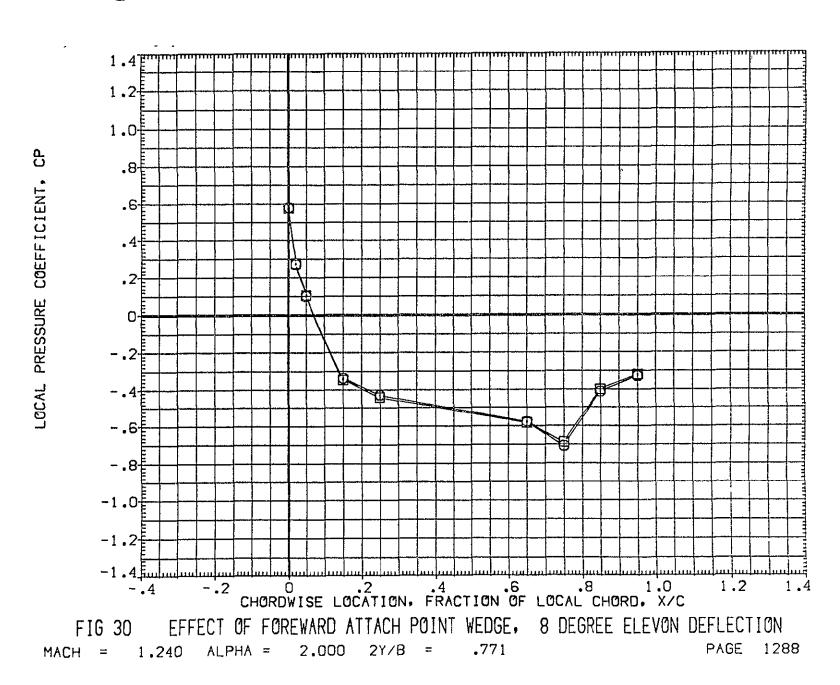


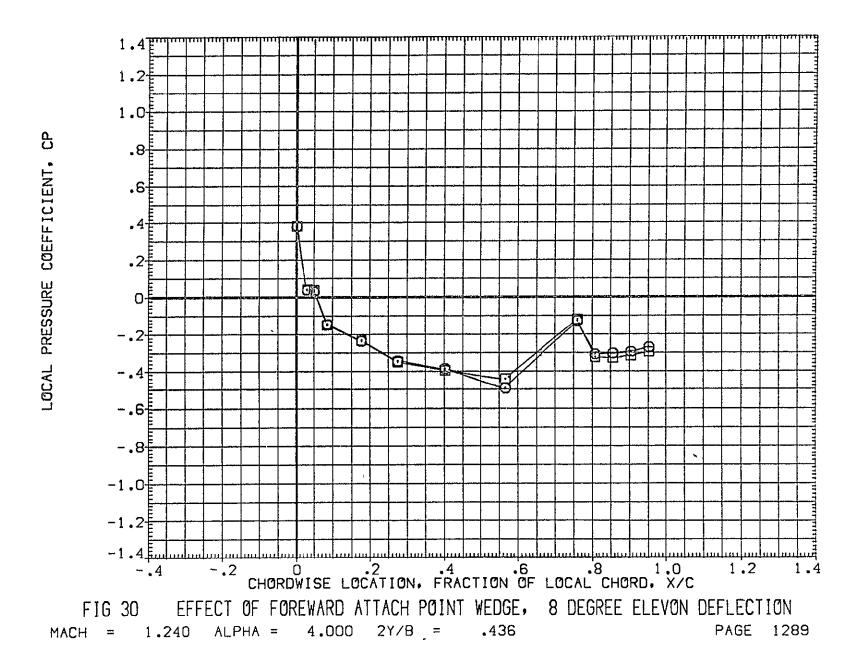


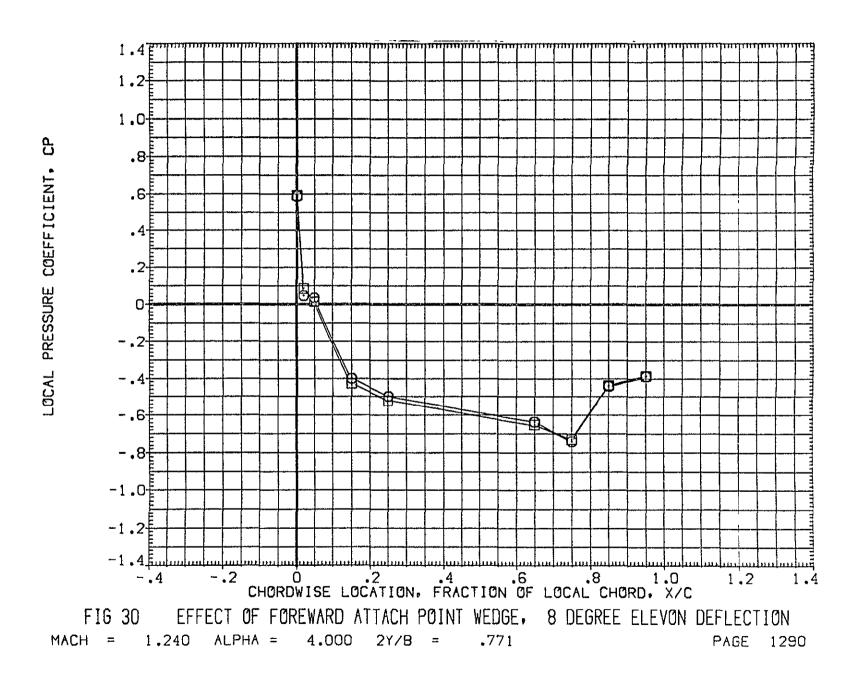


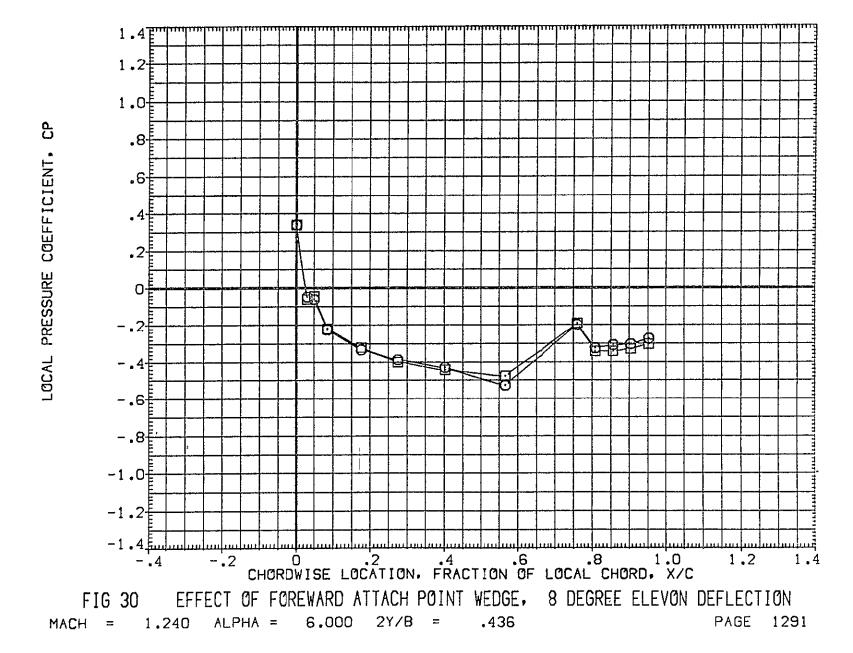


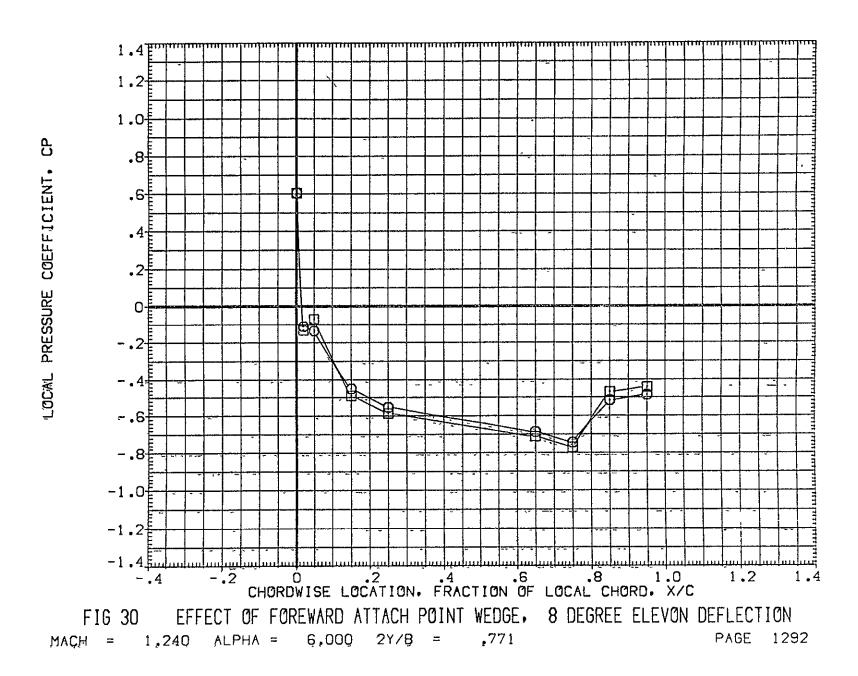


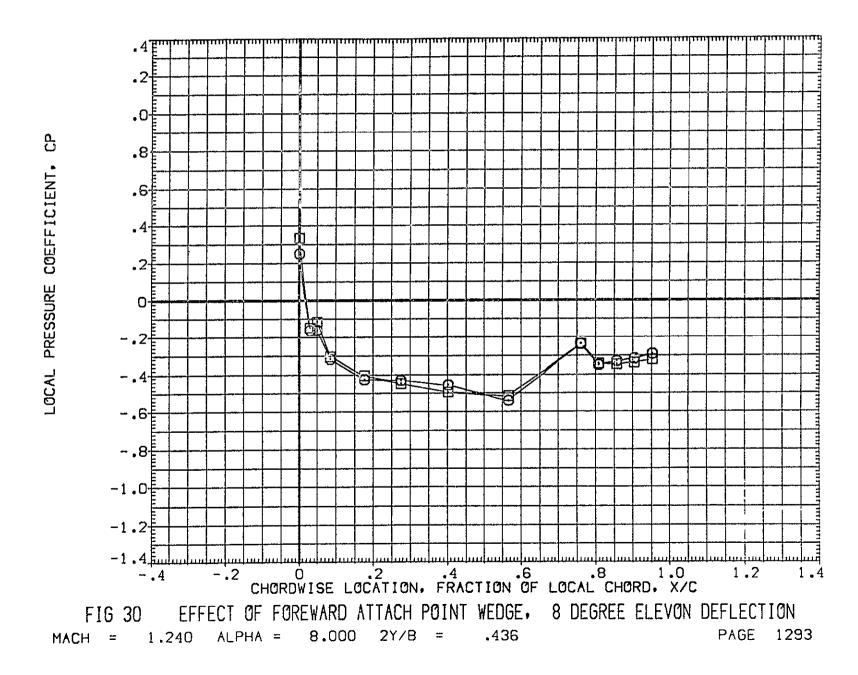


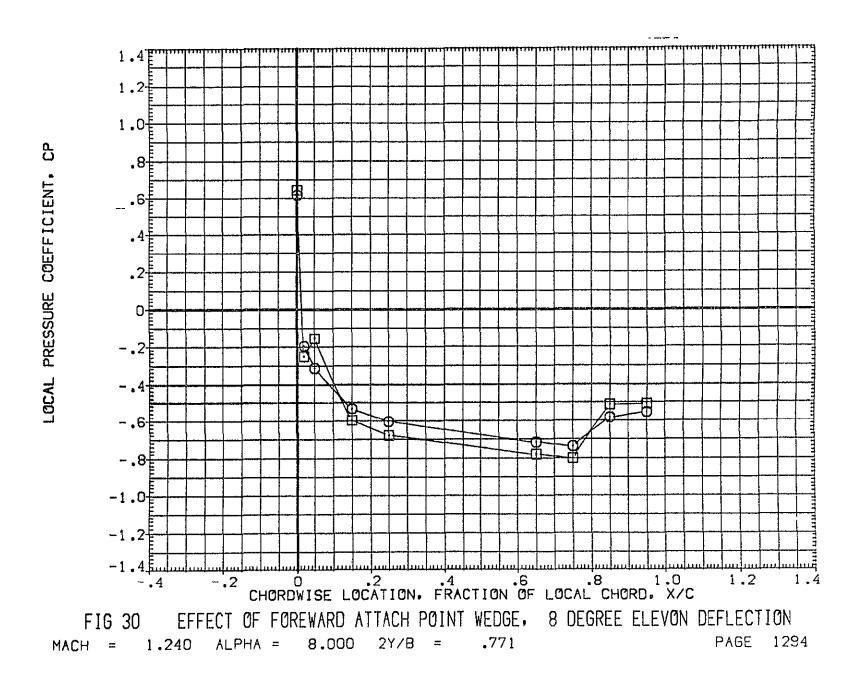


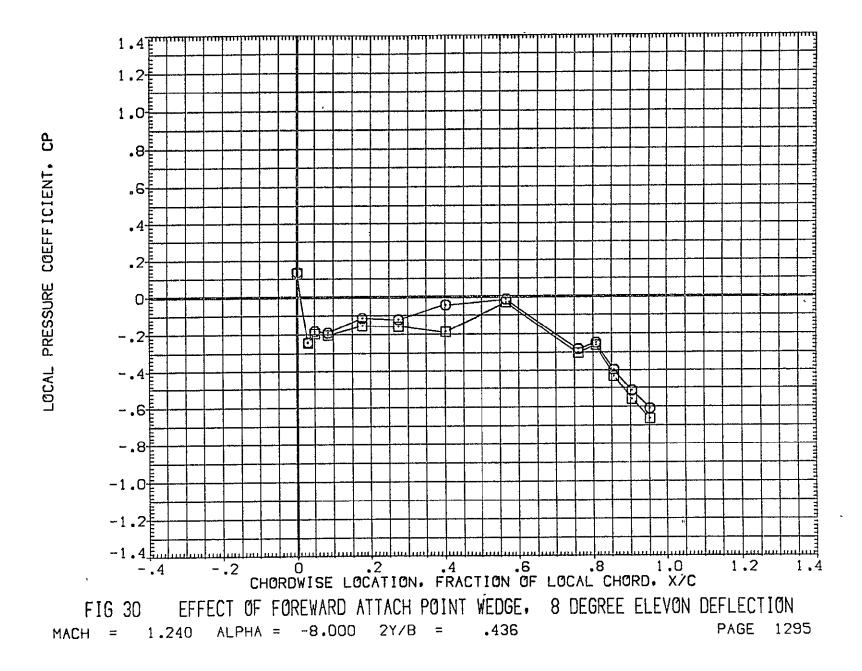


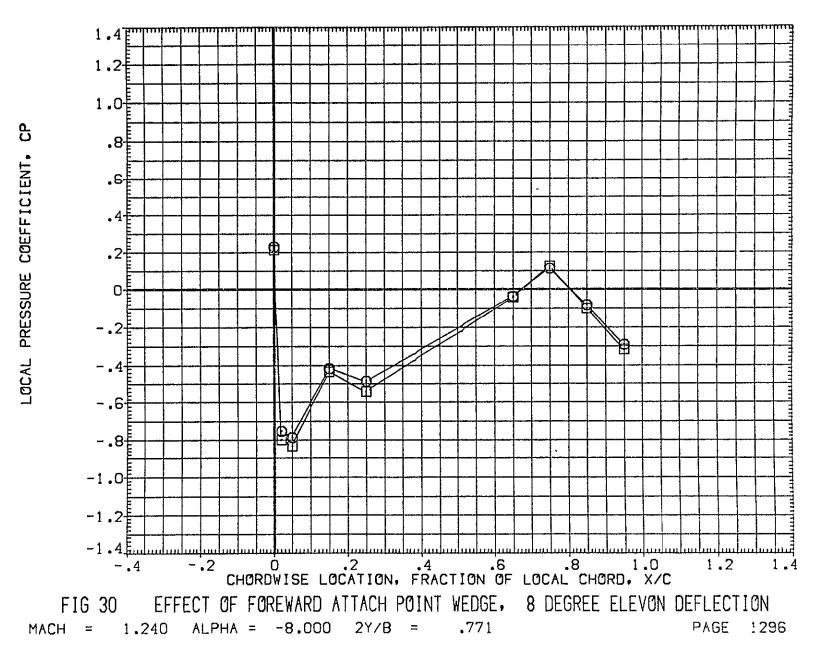


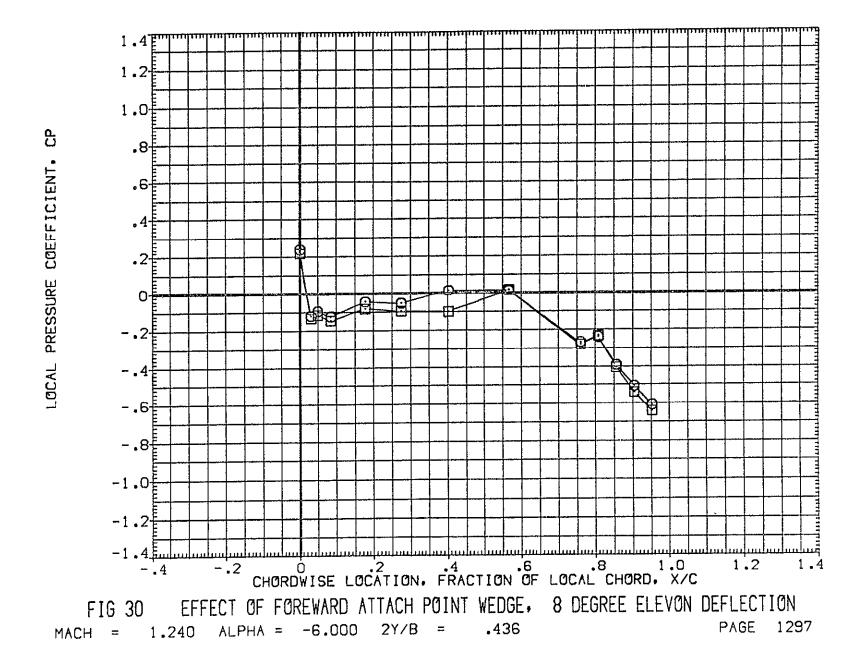


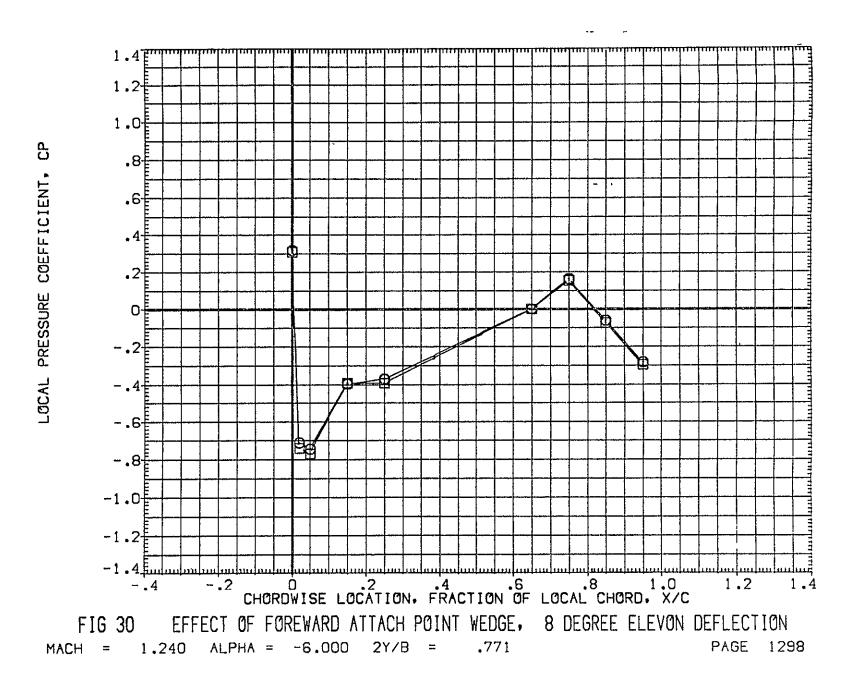


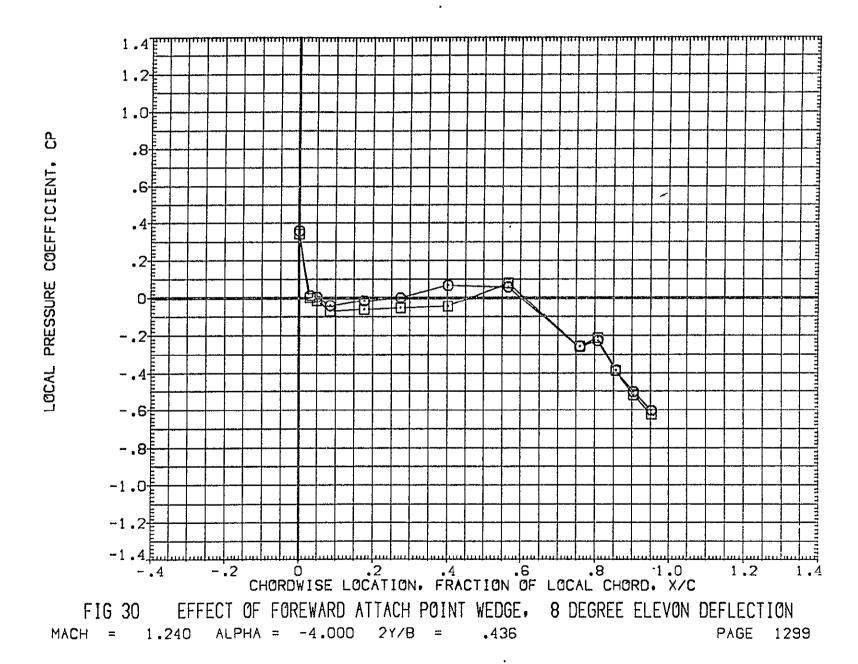


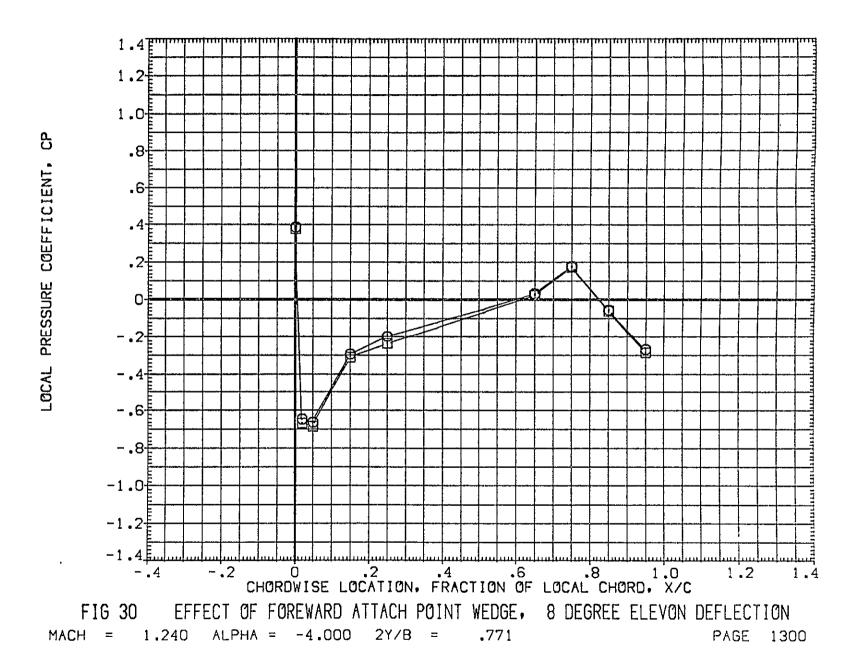


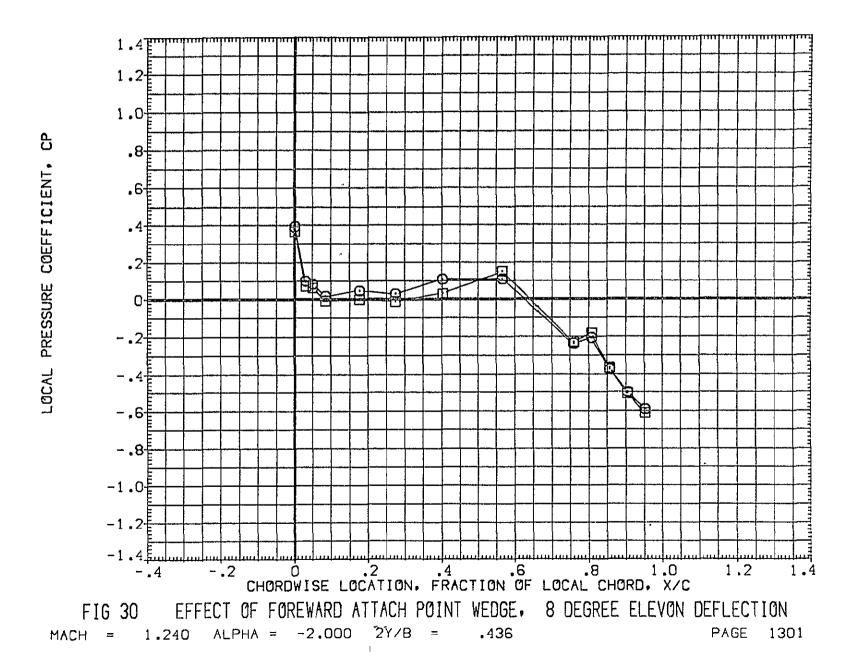


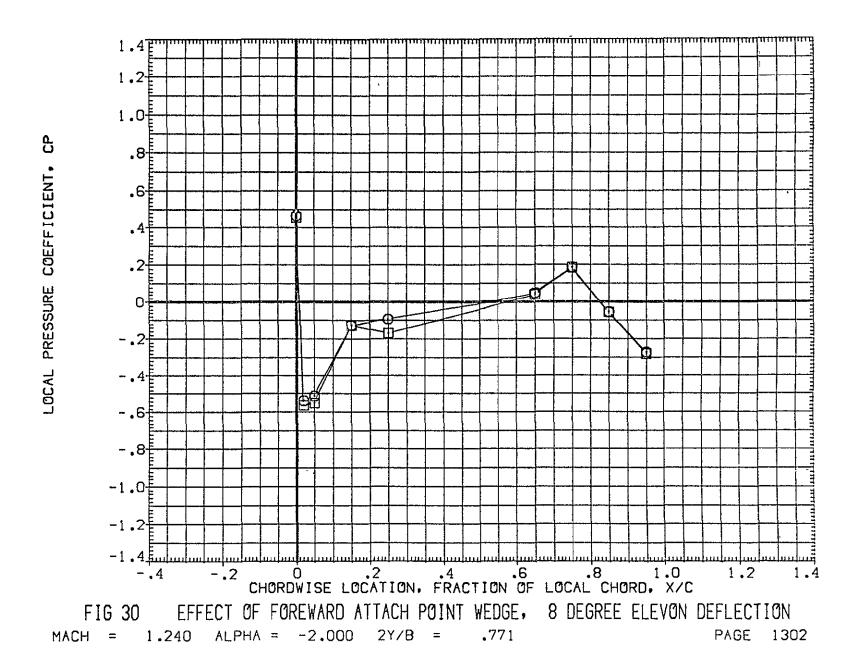


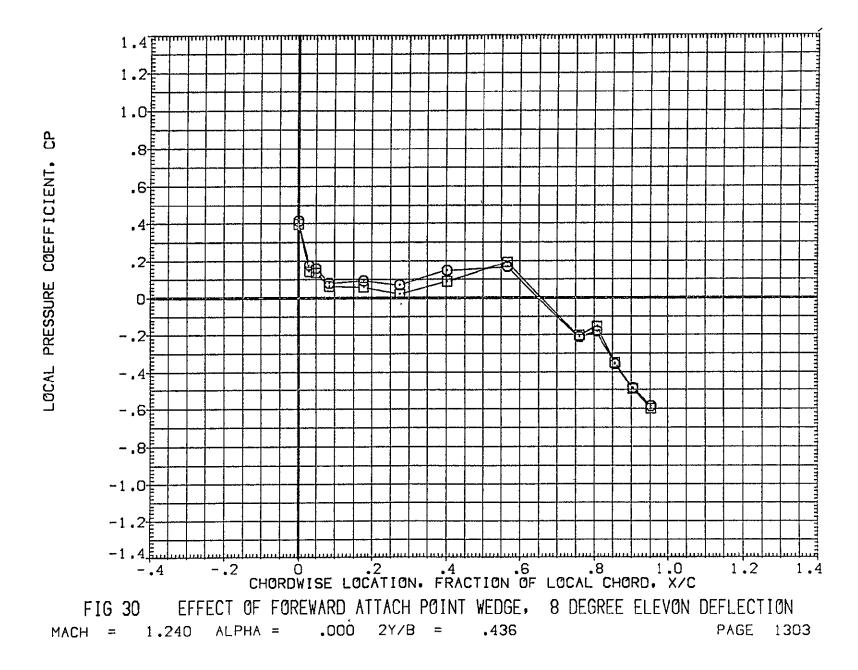


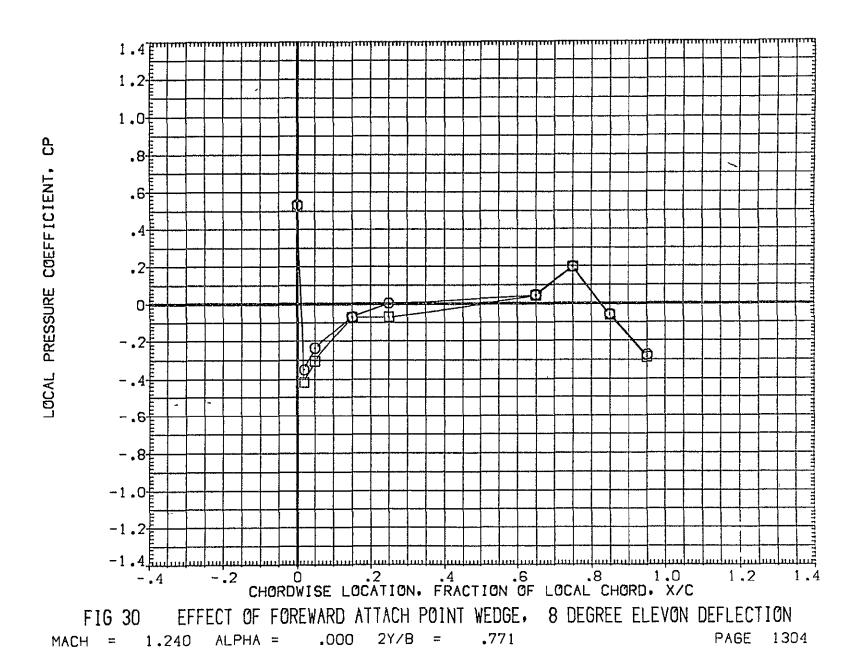




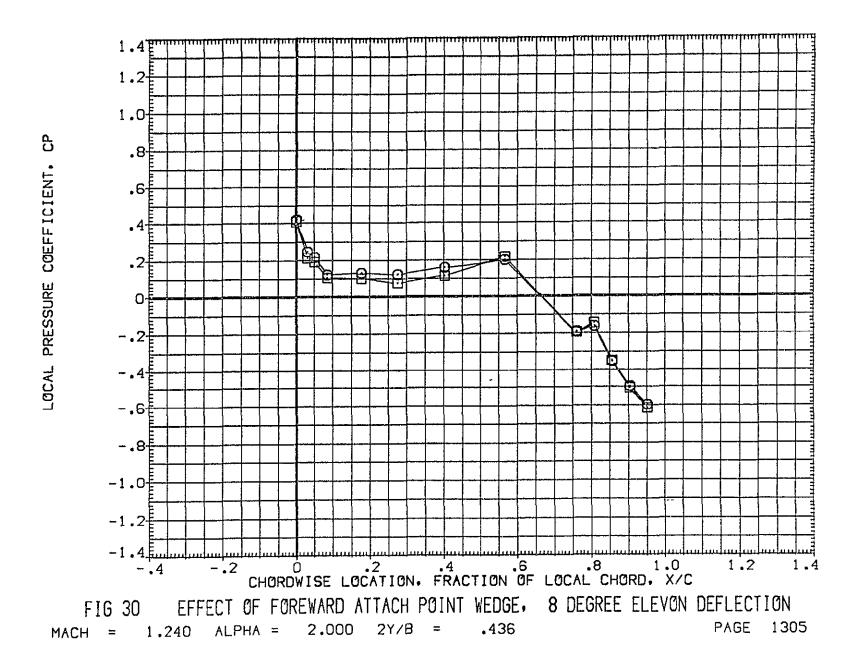


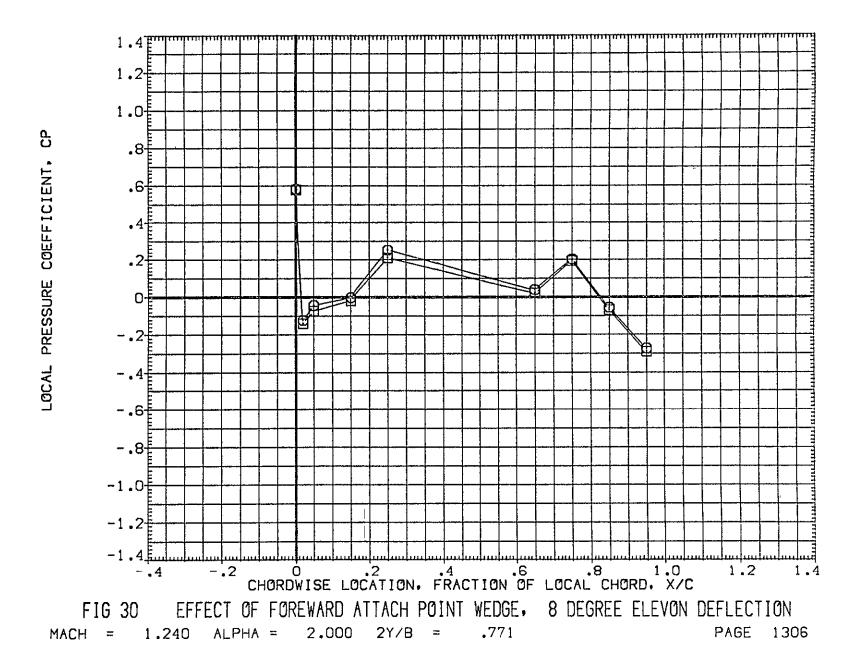


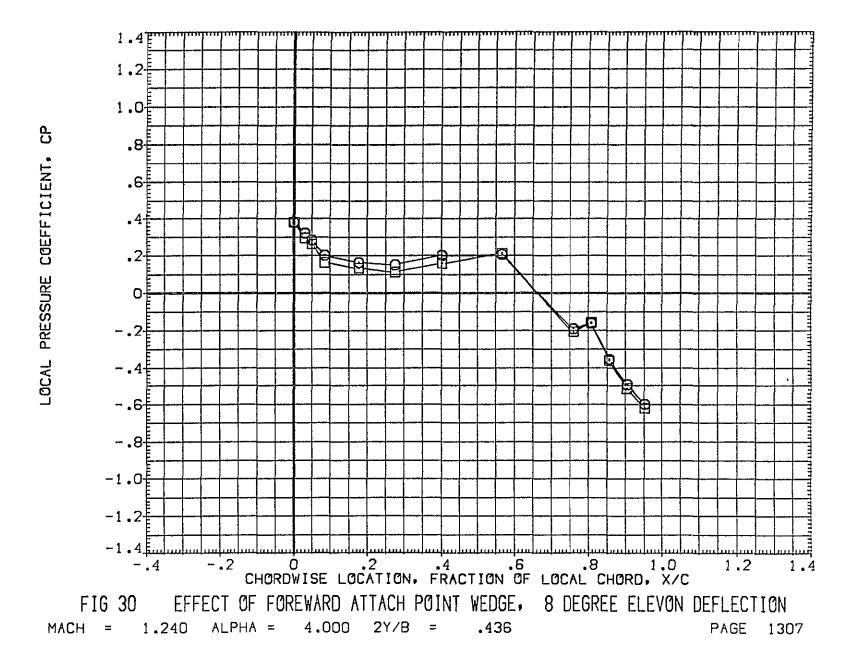


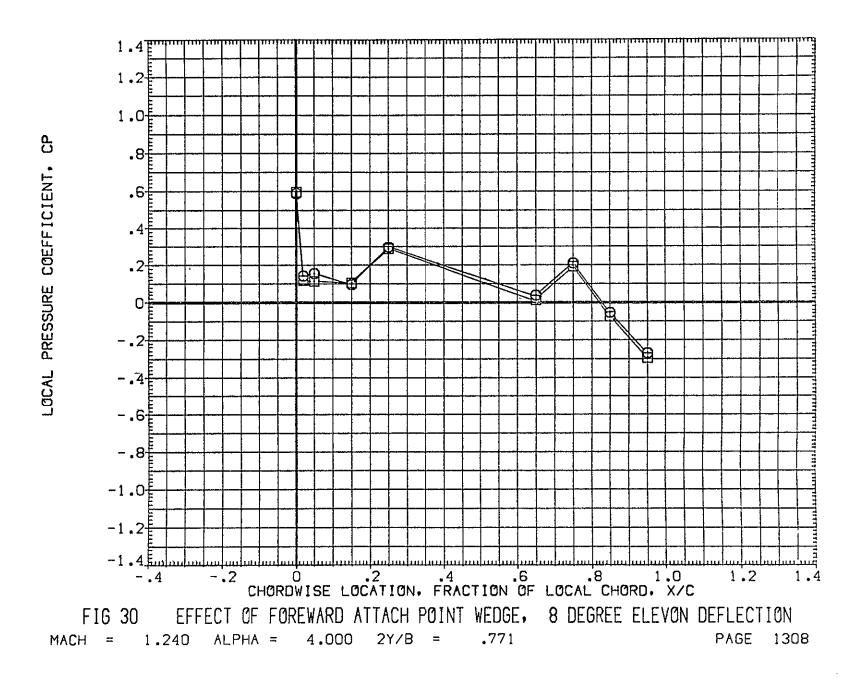


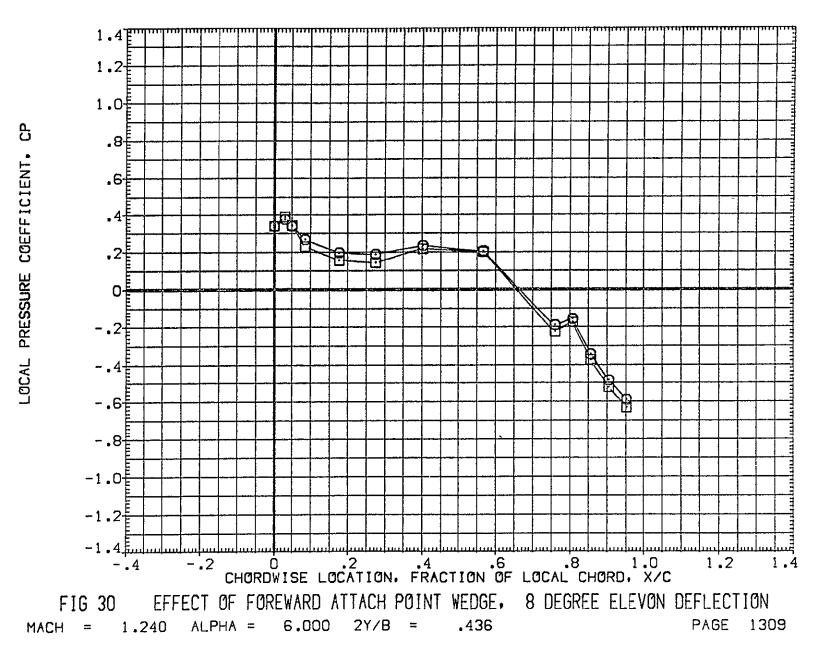
ELV-4

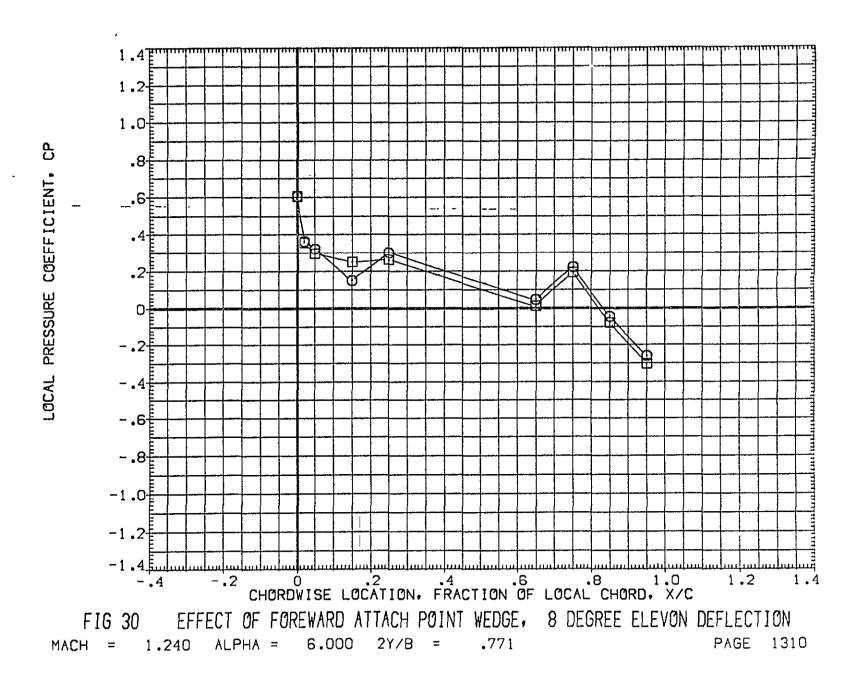


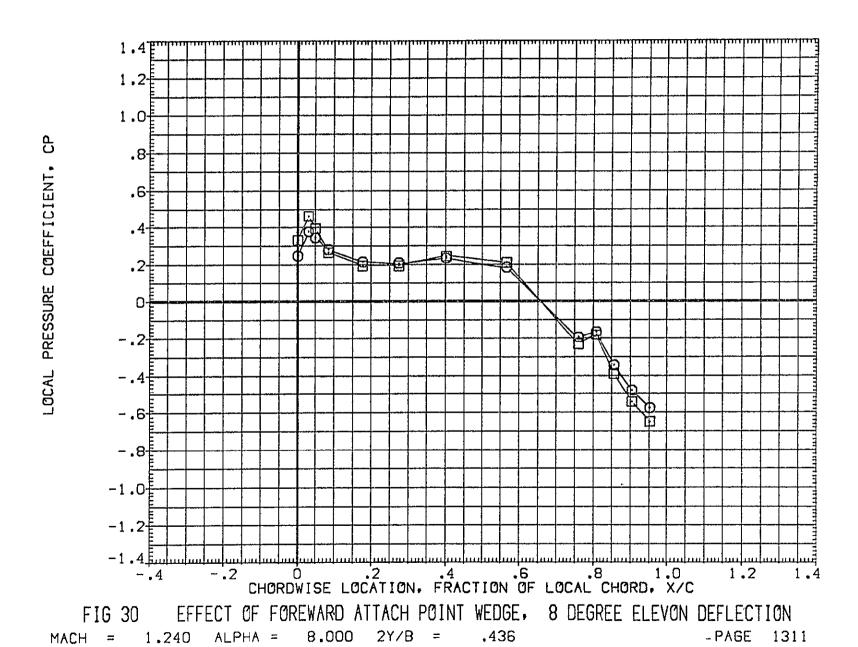


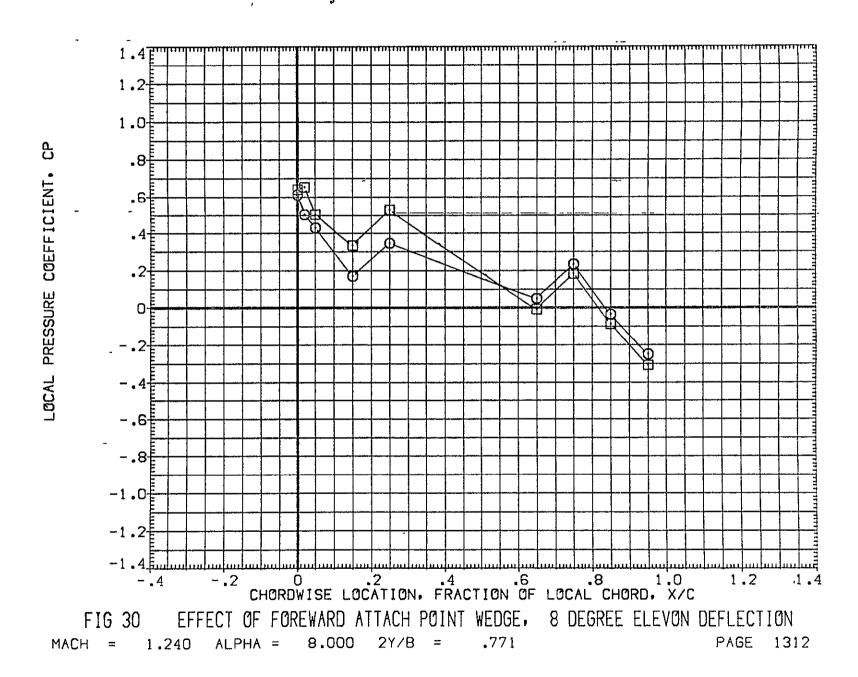


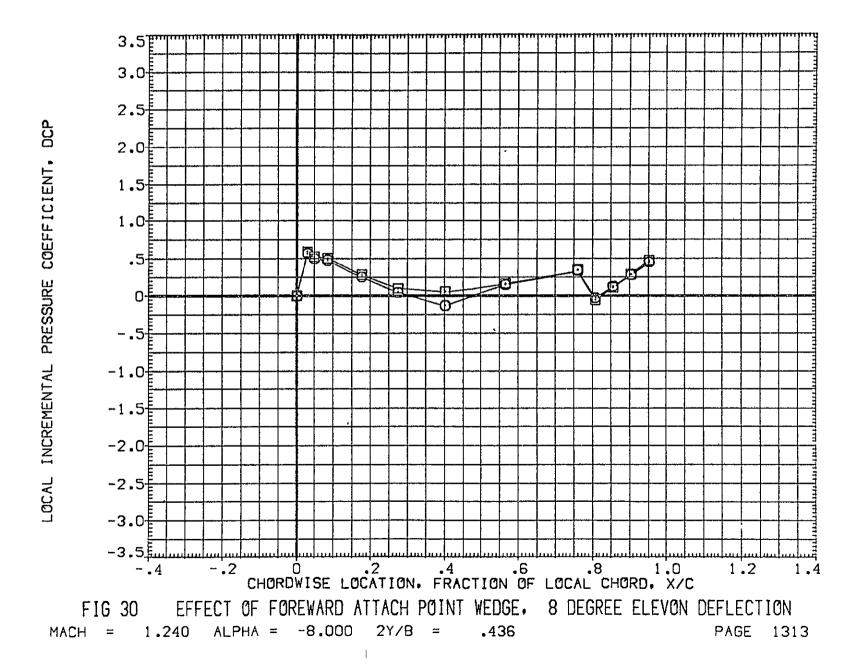


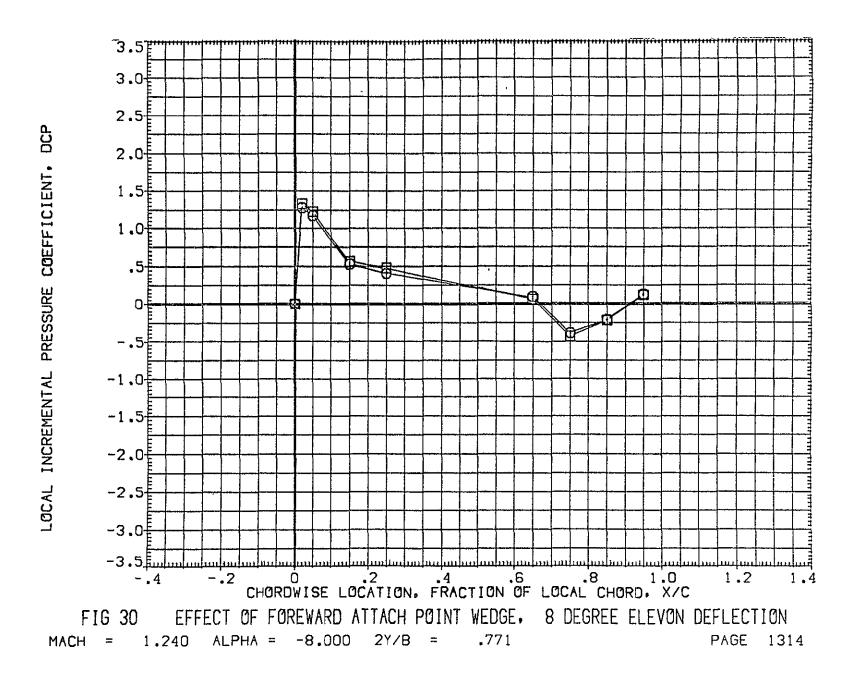


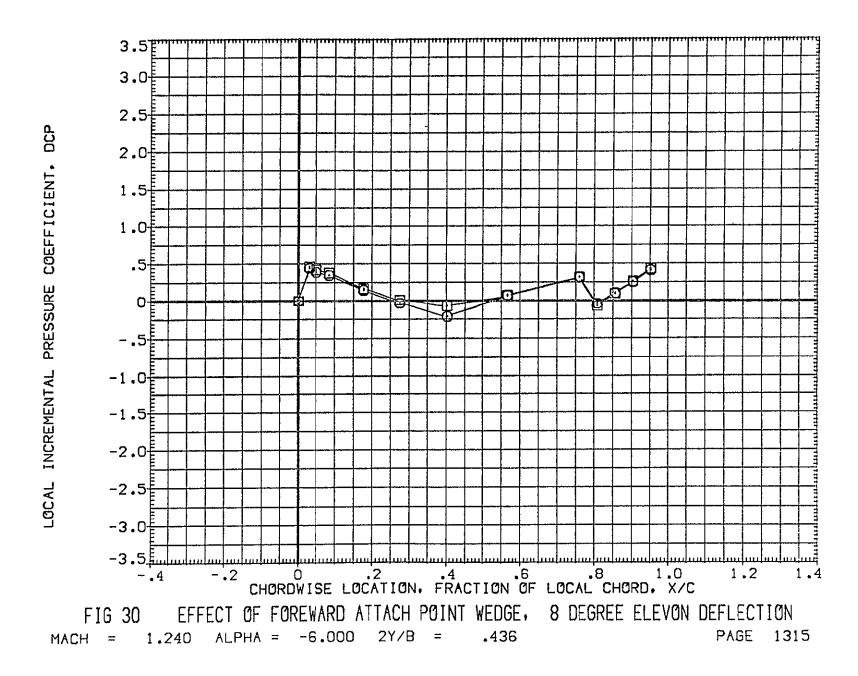


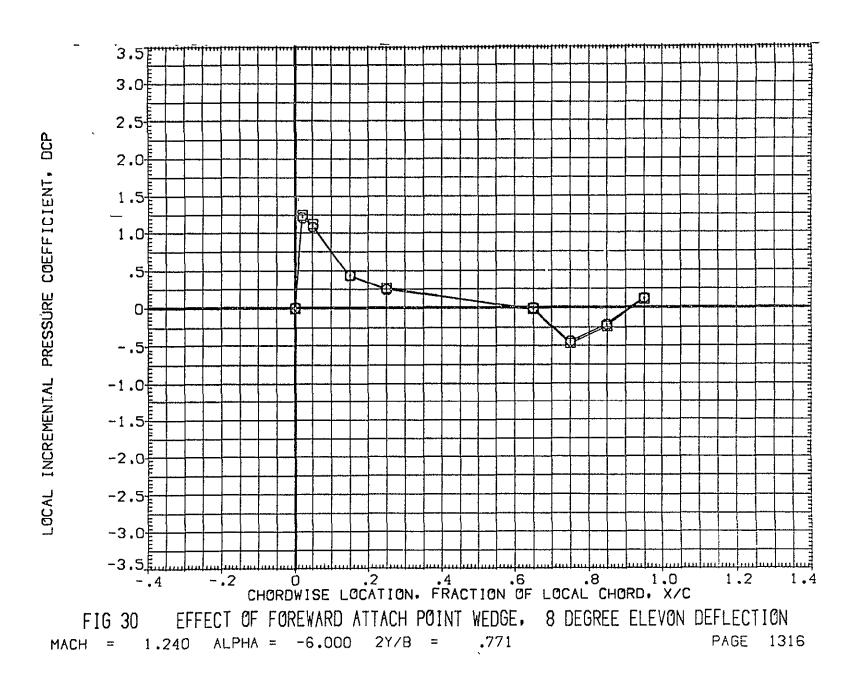


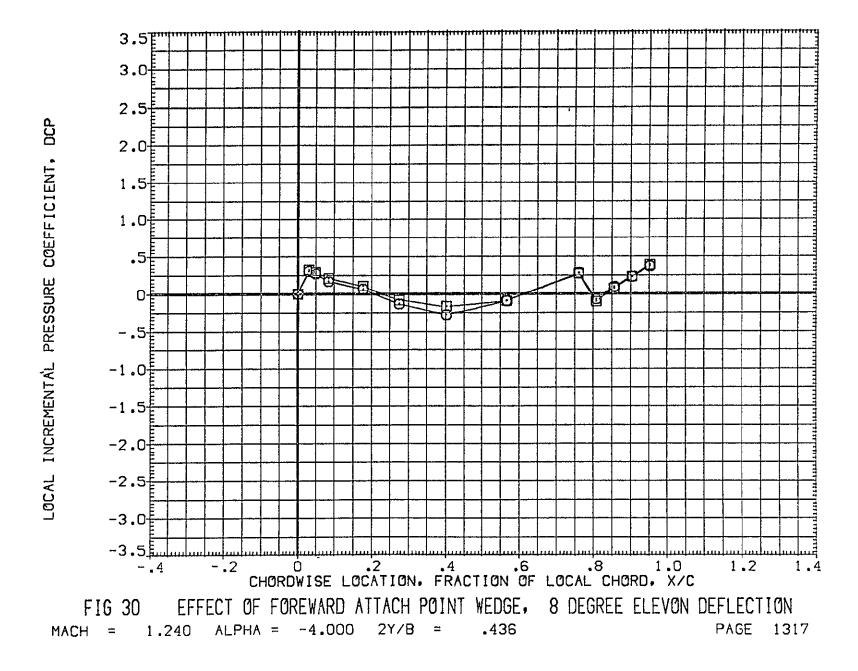


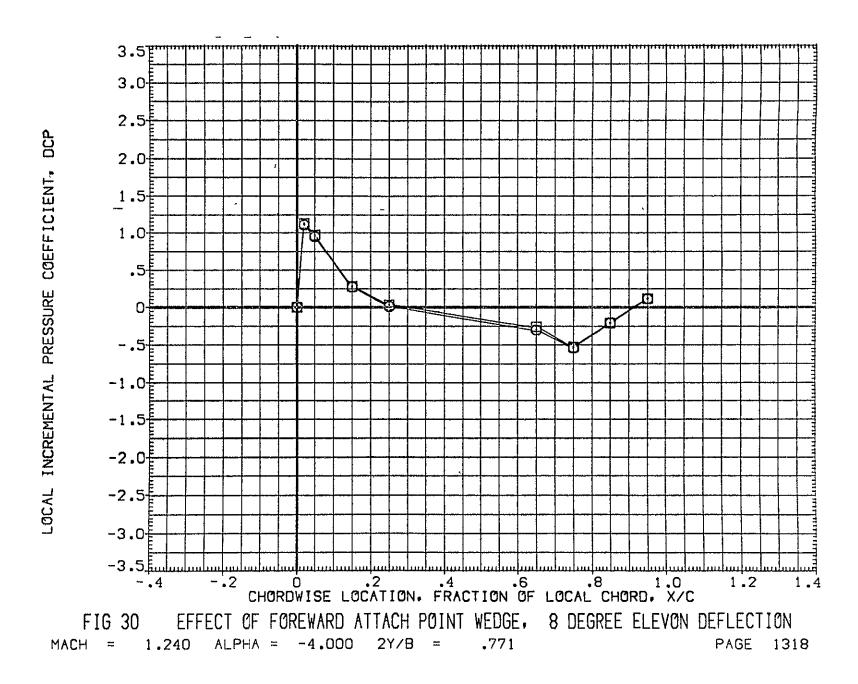


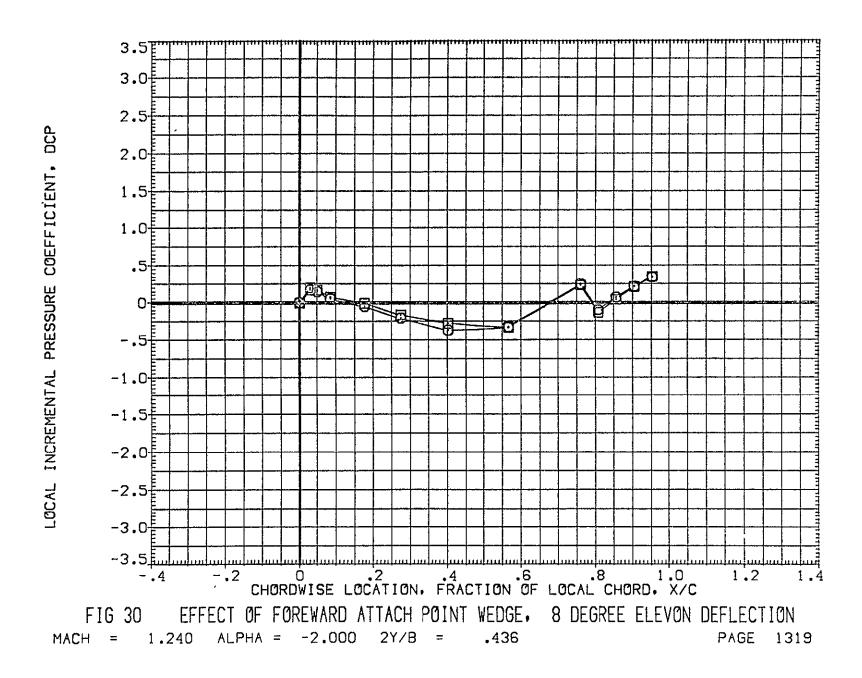


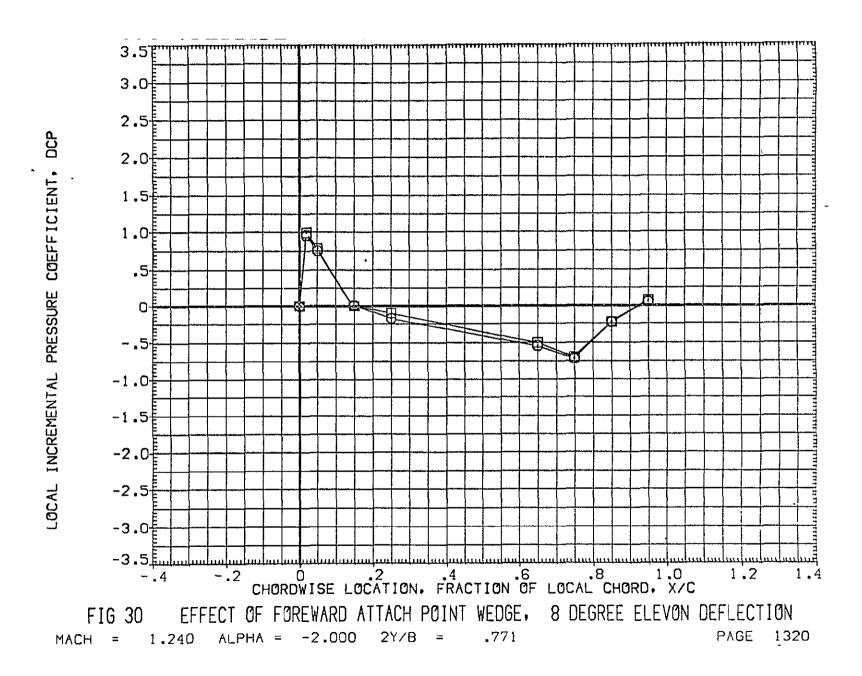


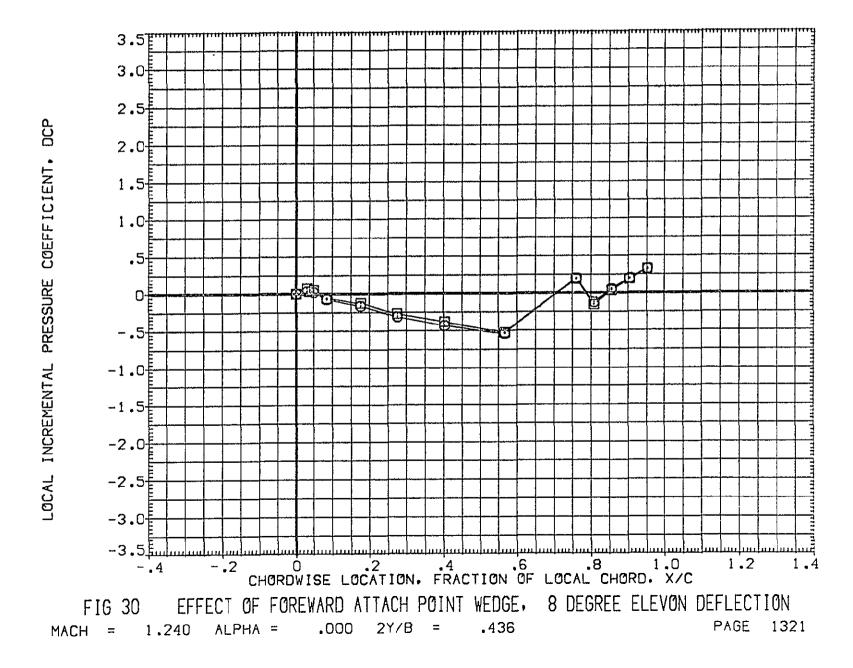


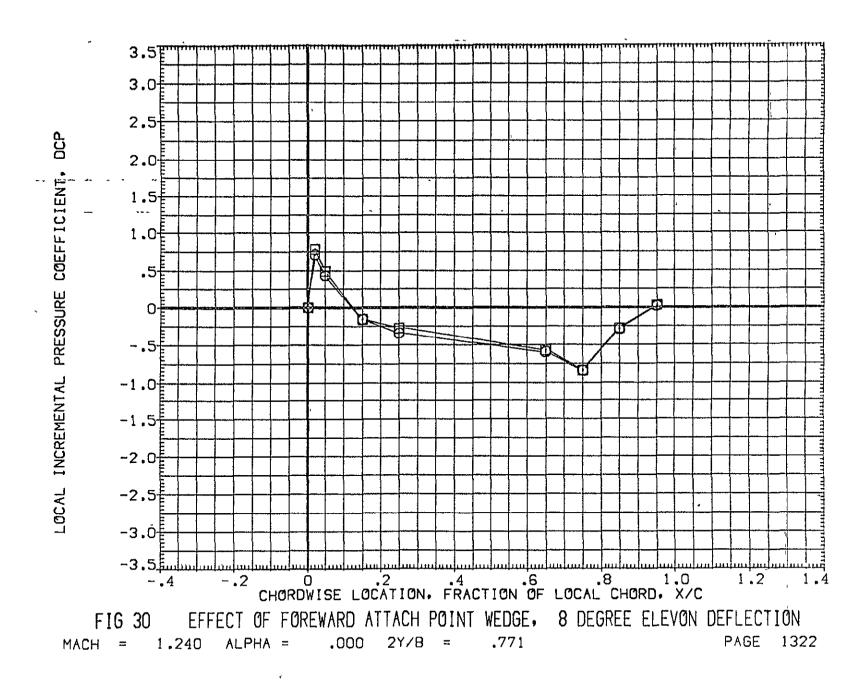


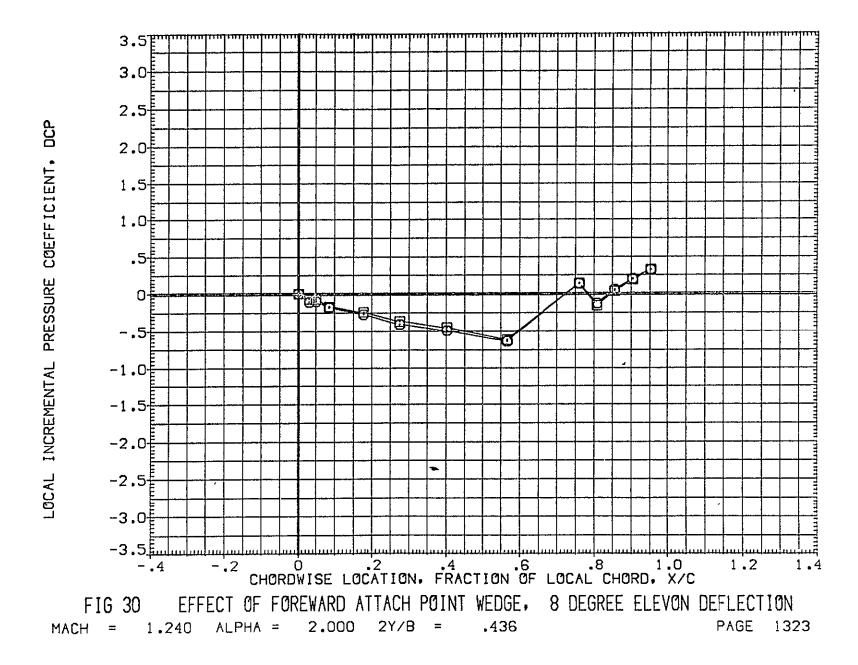


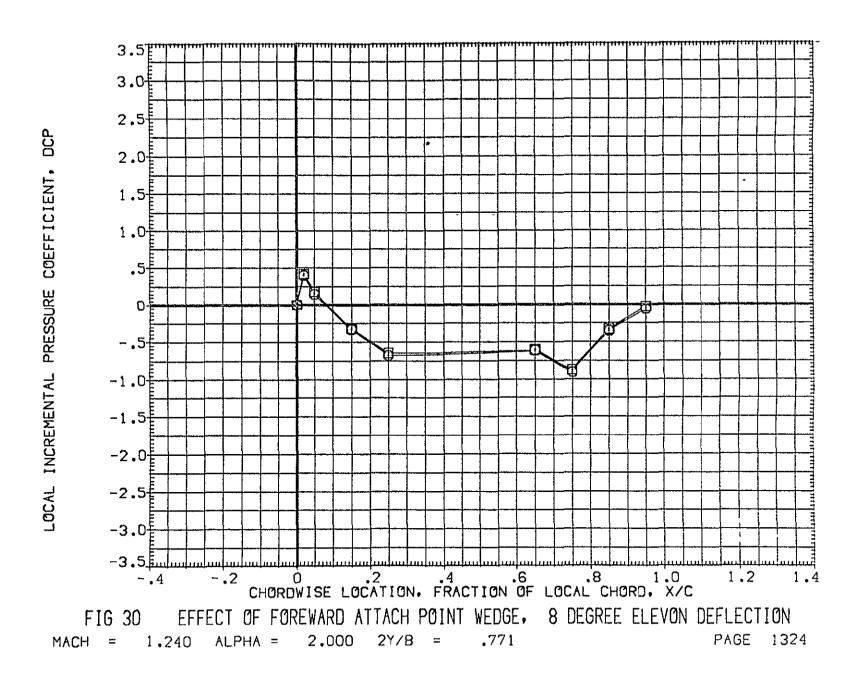


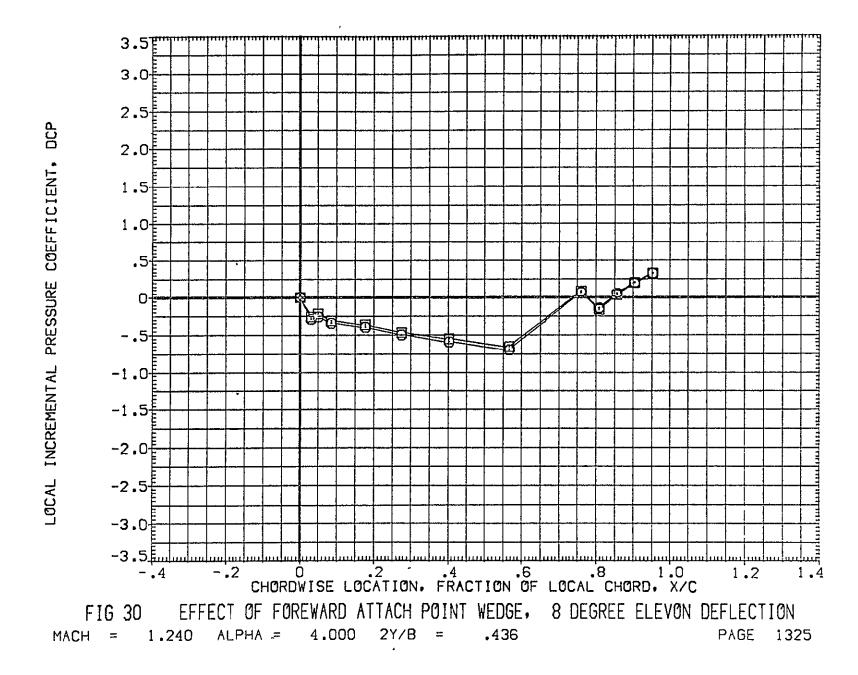


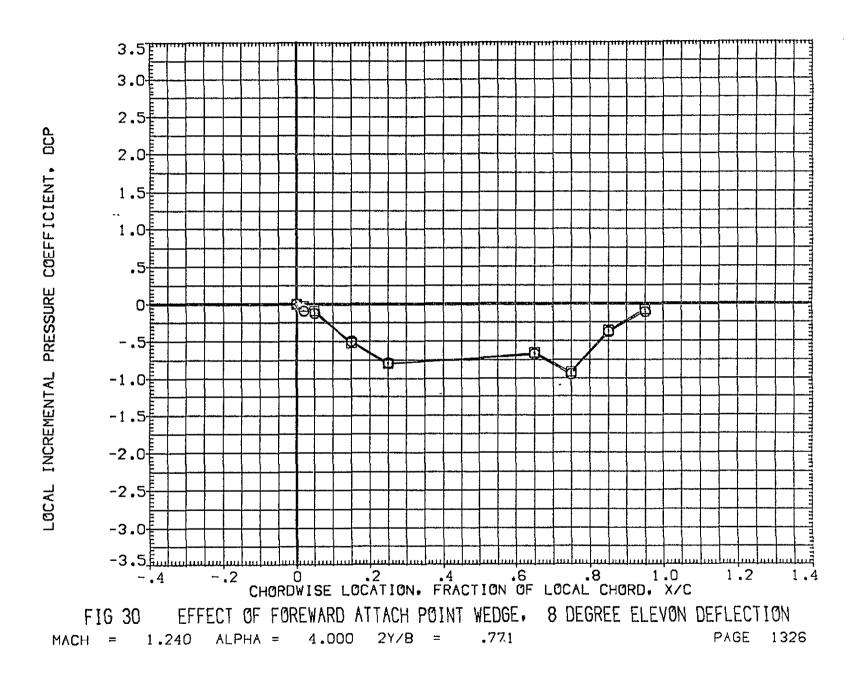


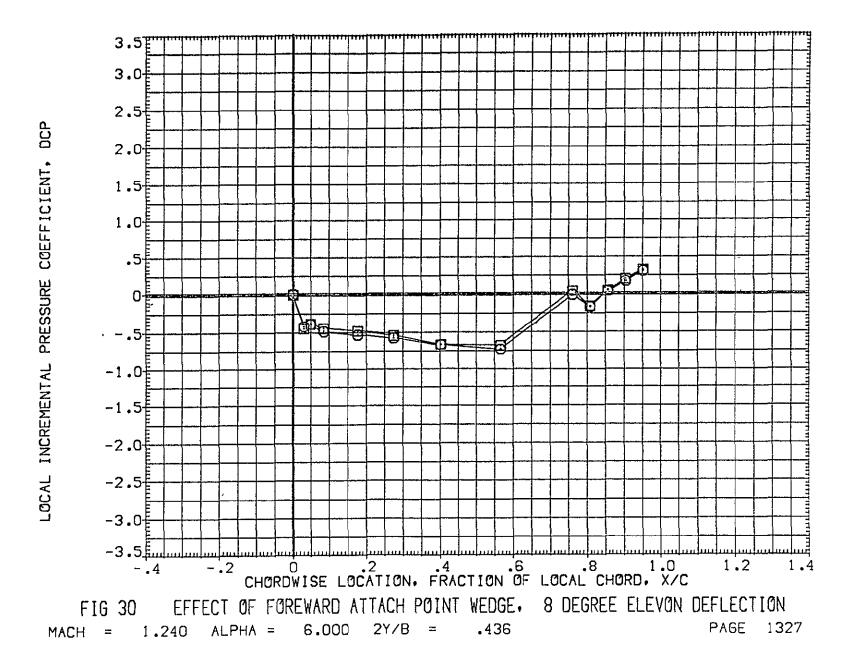


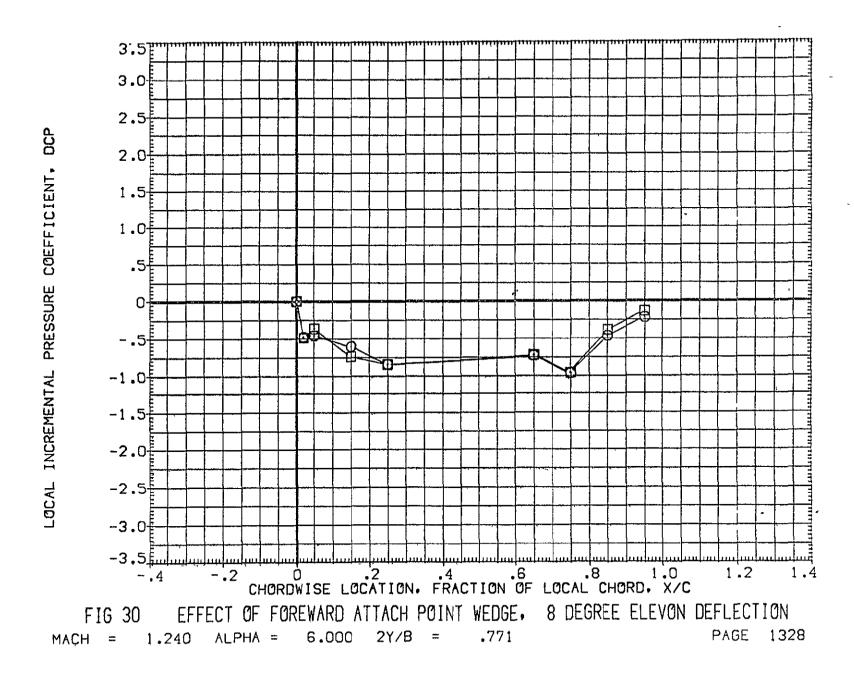


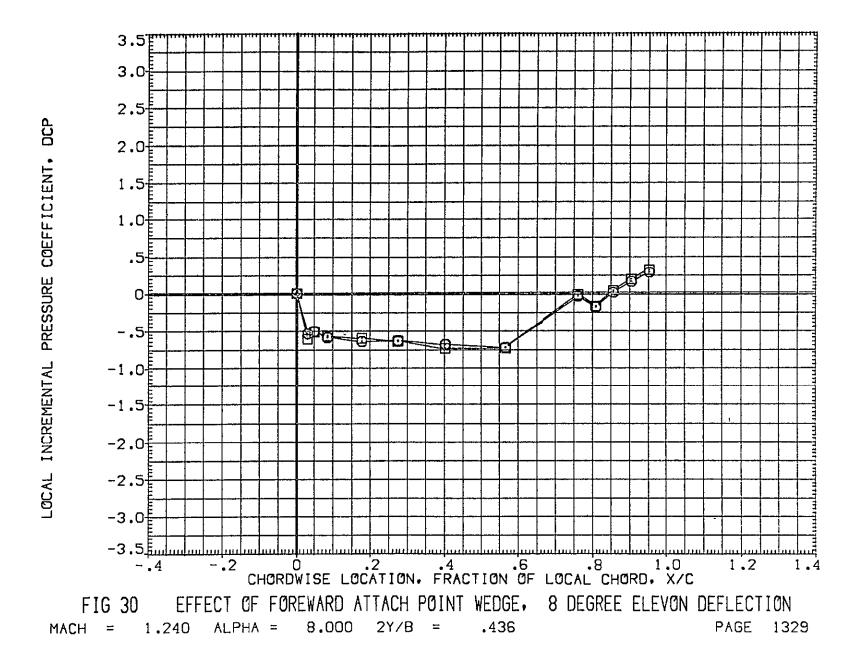


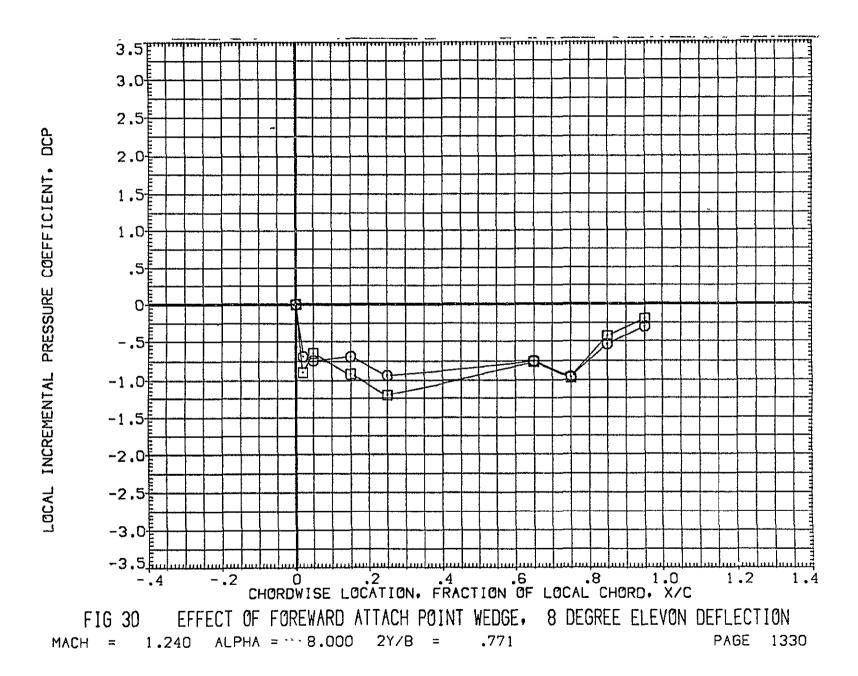


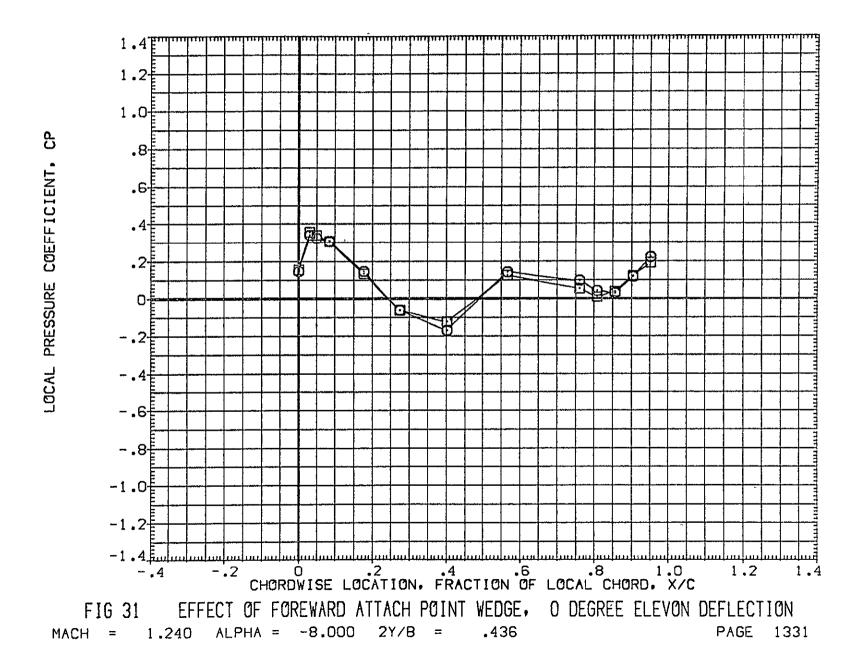


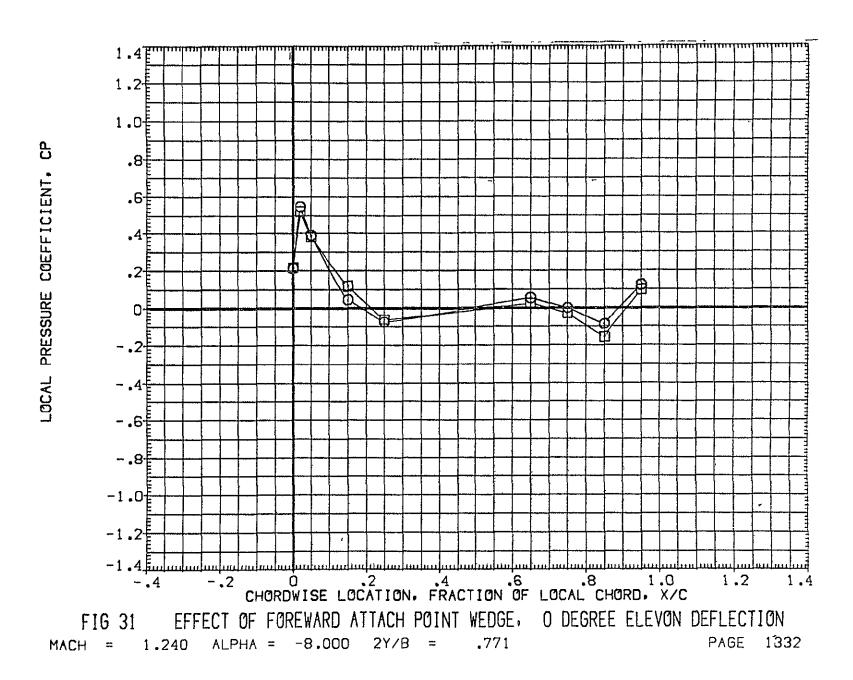


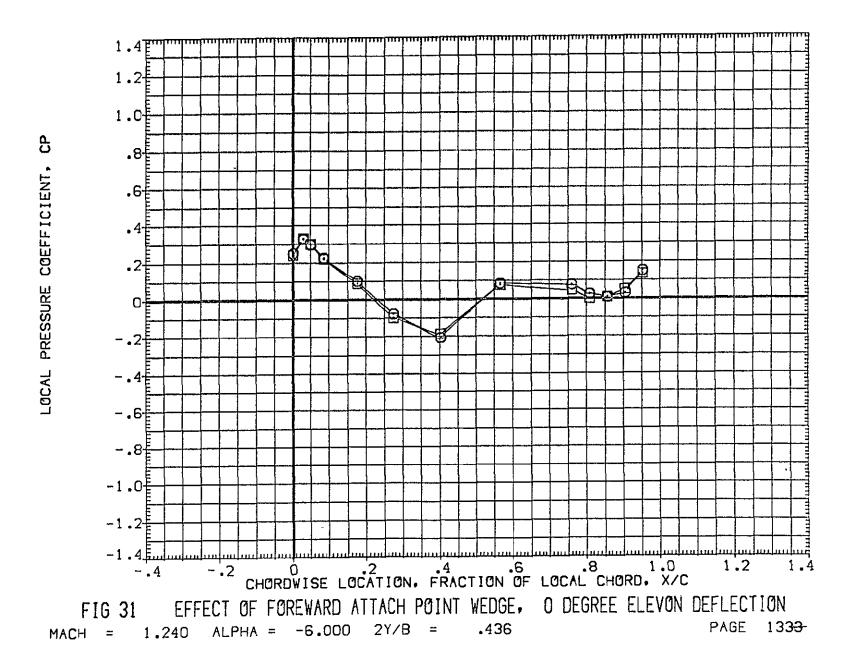




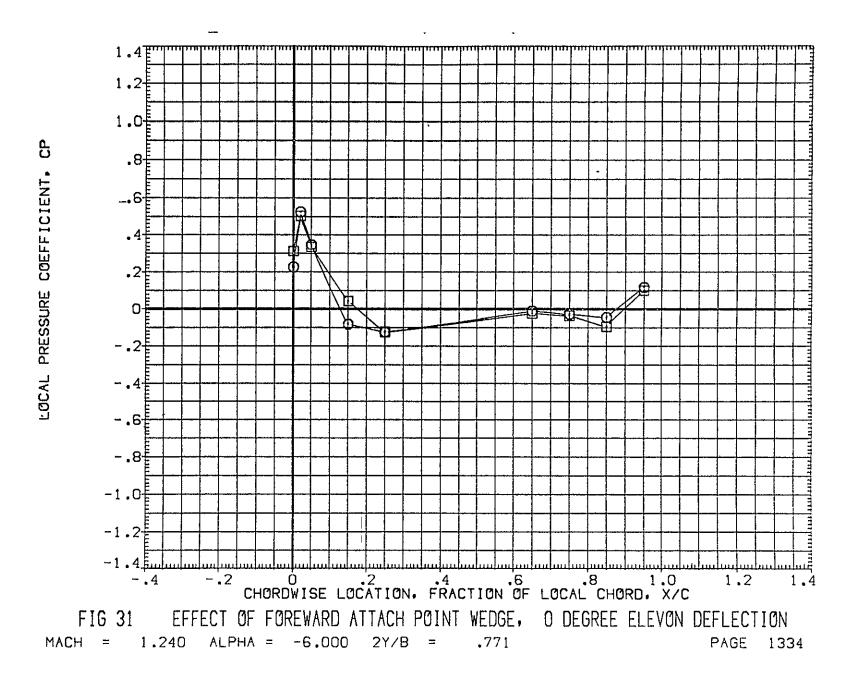




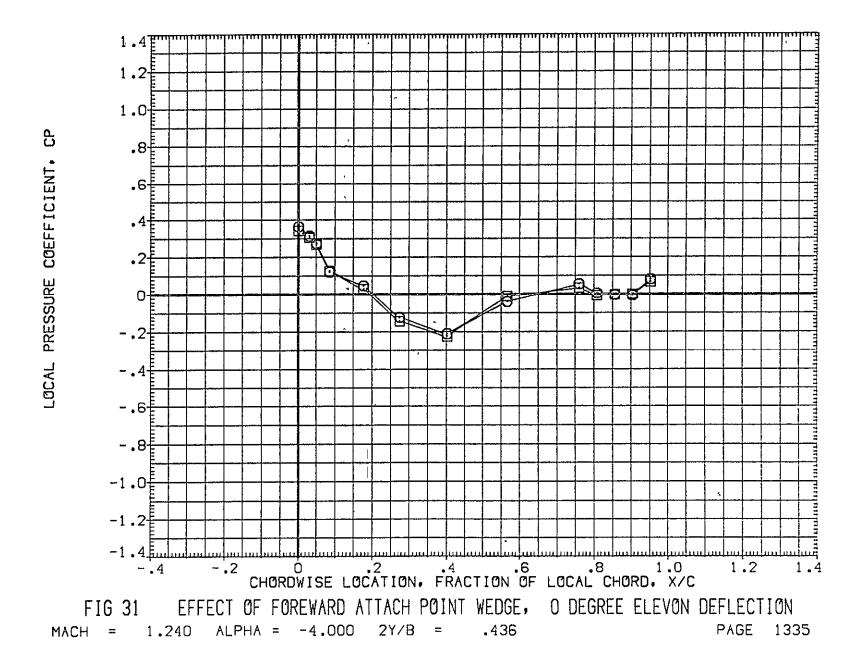




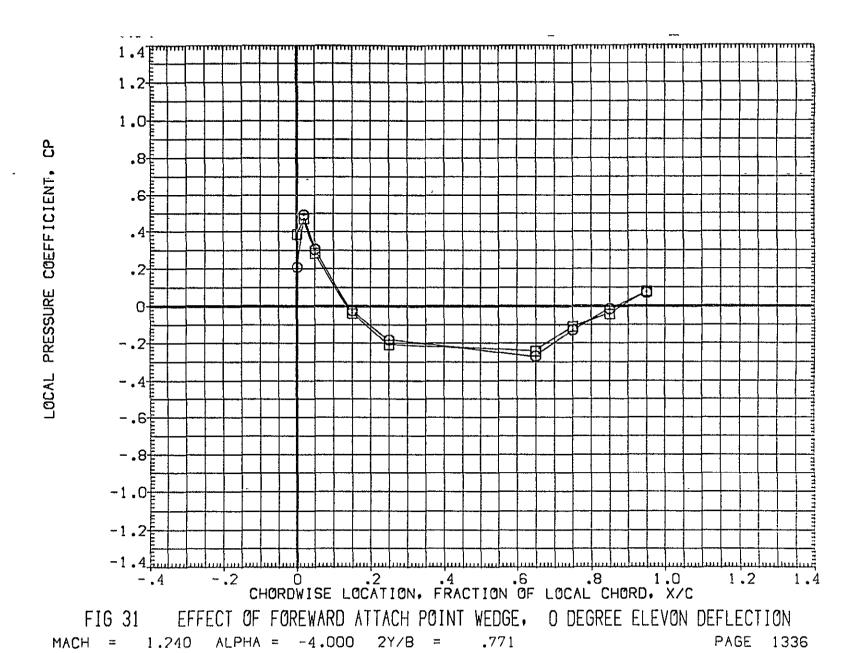
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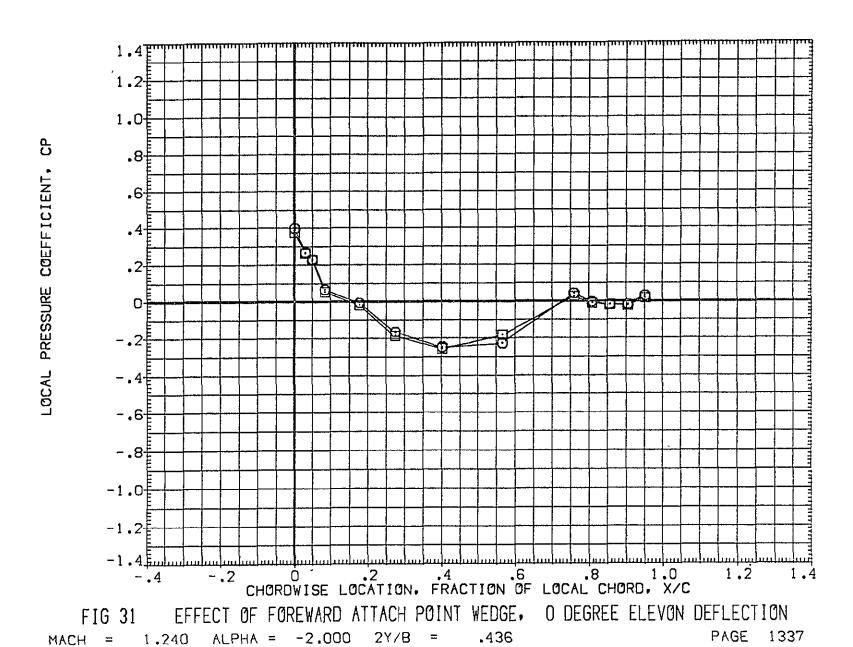


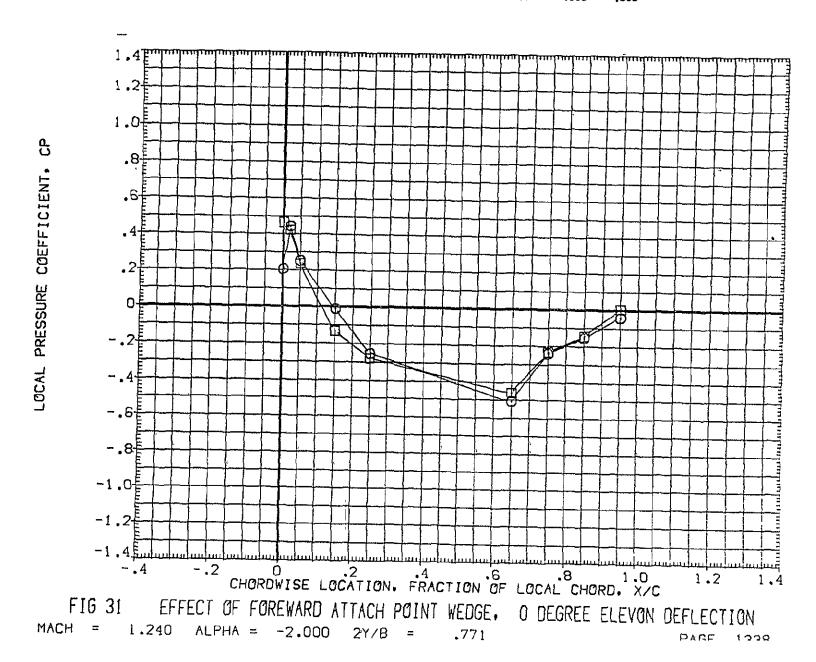
0N ELV-1 ELV-2 ELV-3 ELV-4 WING UPPER SURFACE .000 .000 .000 .000 WING UPPER SURFACE .000 .000 .000 .000

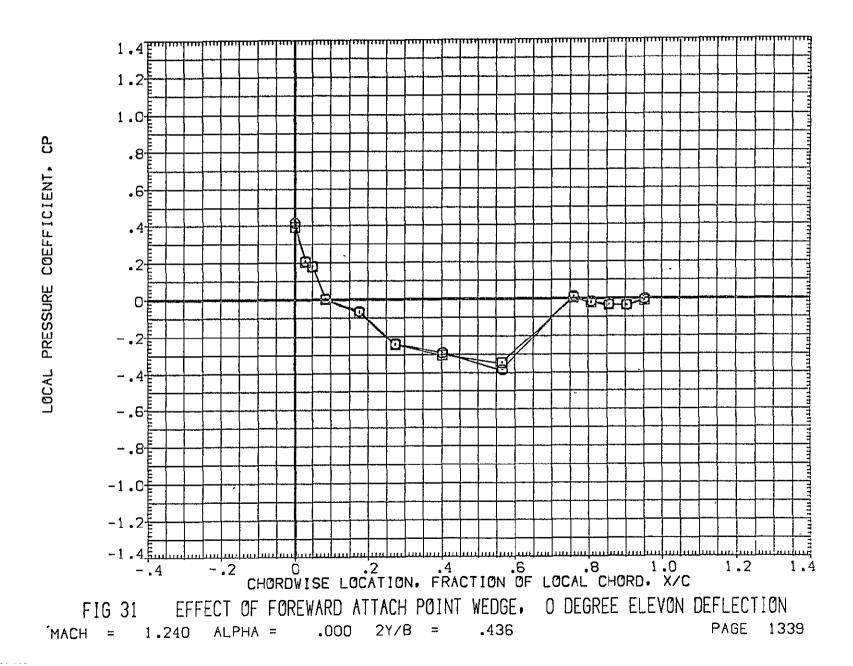


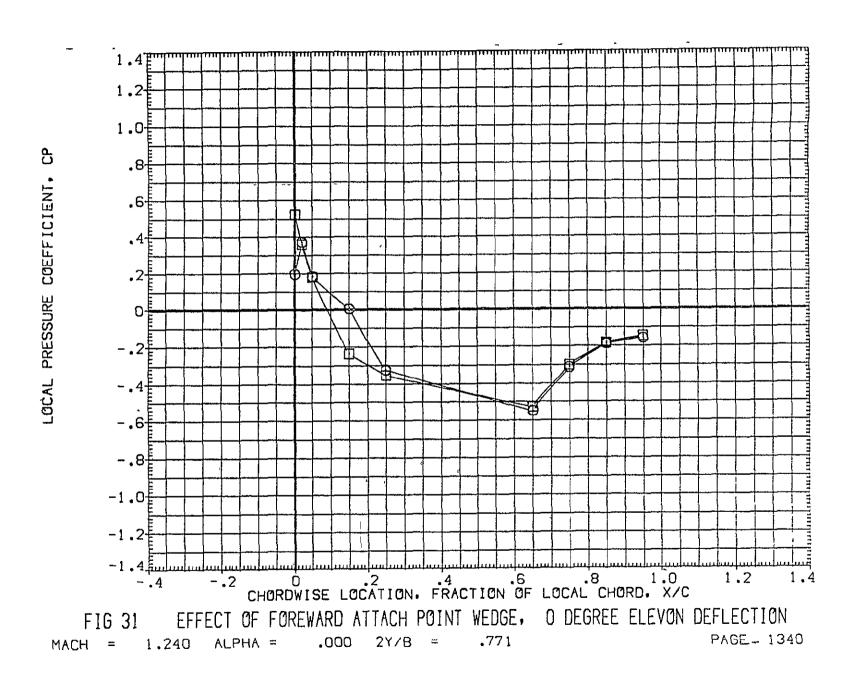
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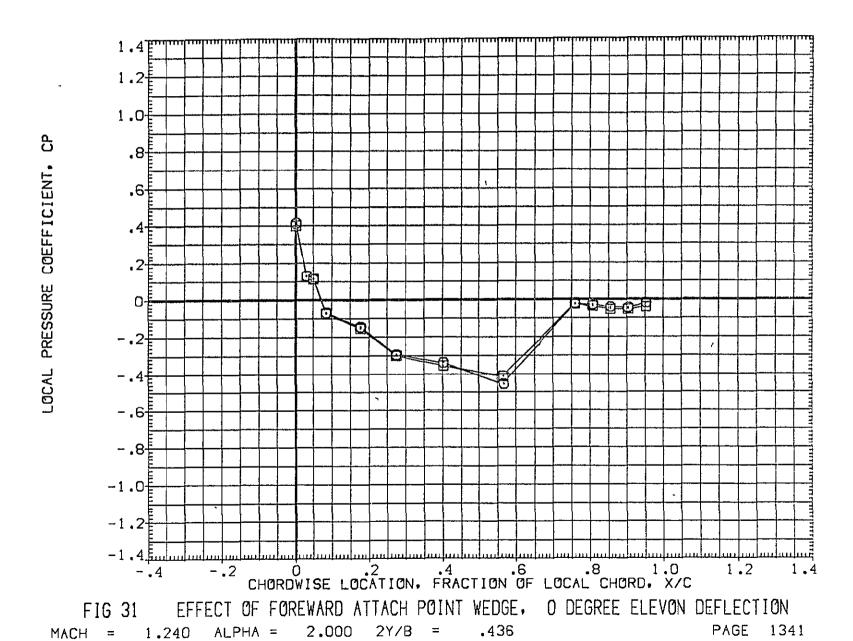


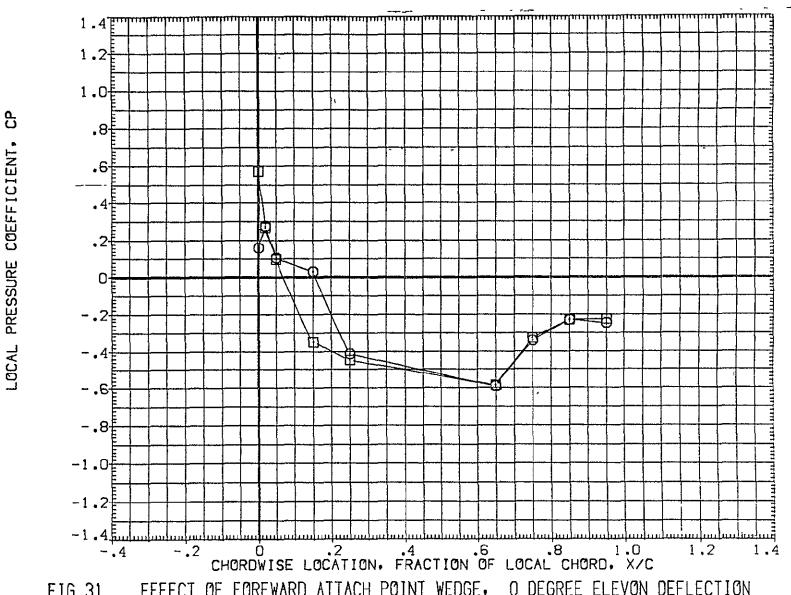




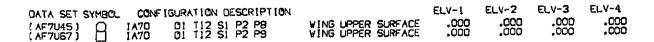


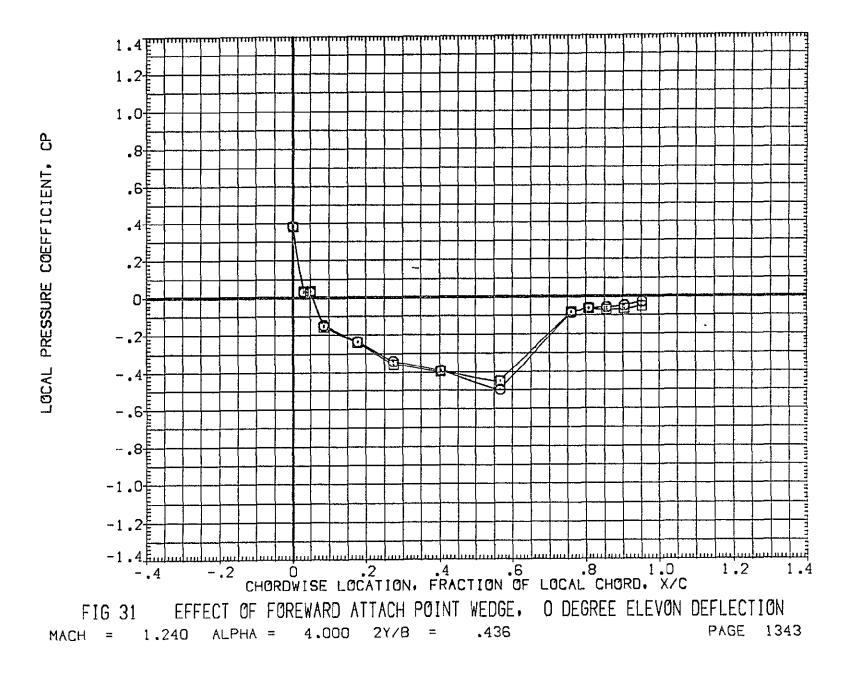


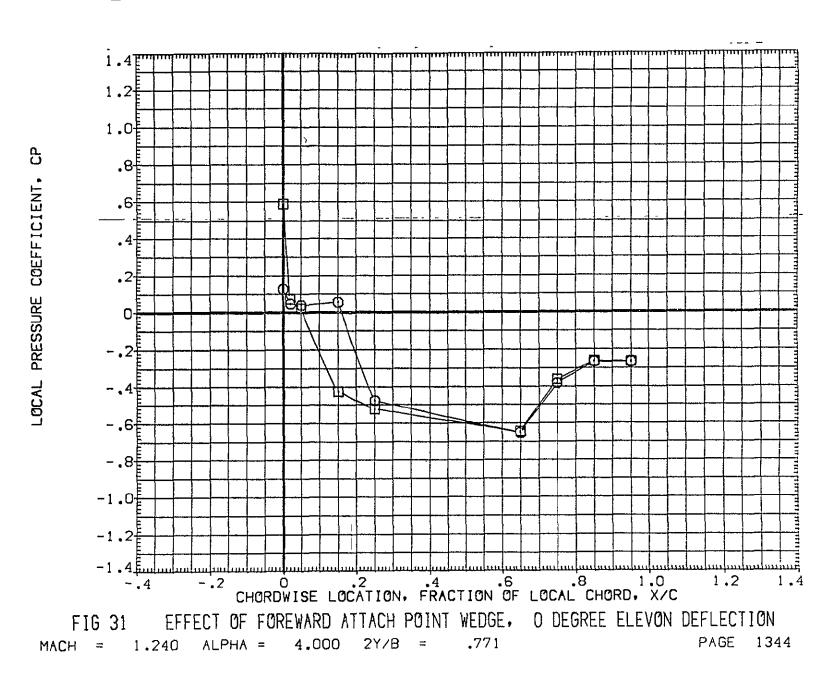




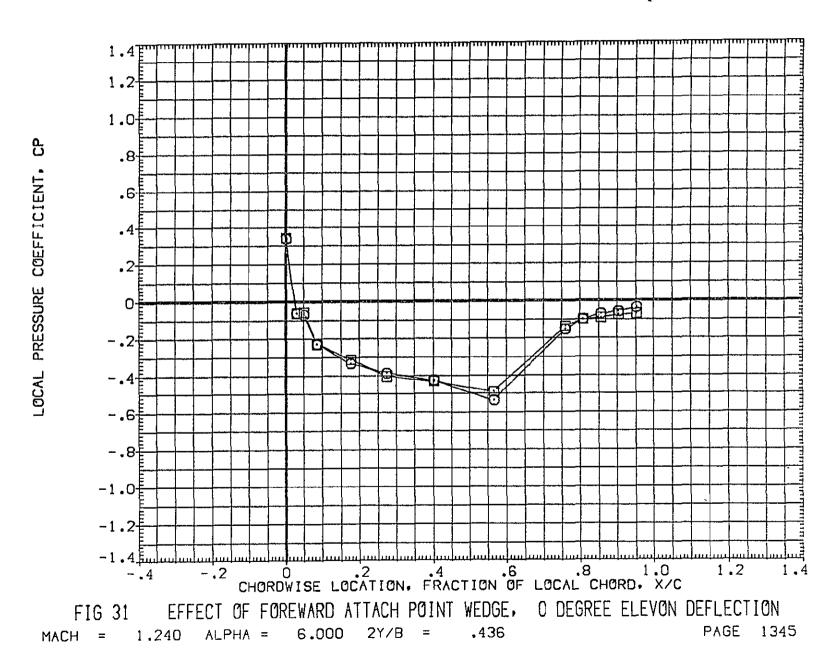
EFFECT OF FOREWARD ATTACH POINT WEDGE, O DEGREE ELEVON DEFLECTION MACH = 1.240 ALPHA = 2.000 2Y/B = .771 PAGE 1342

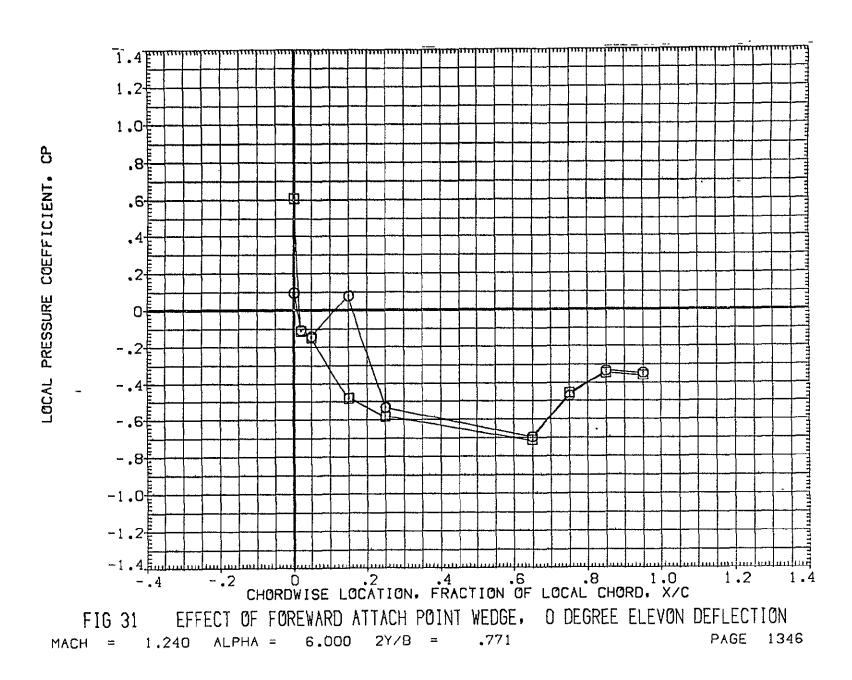


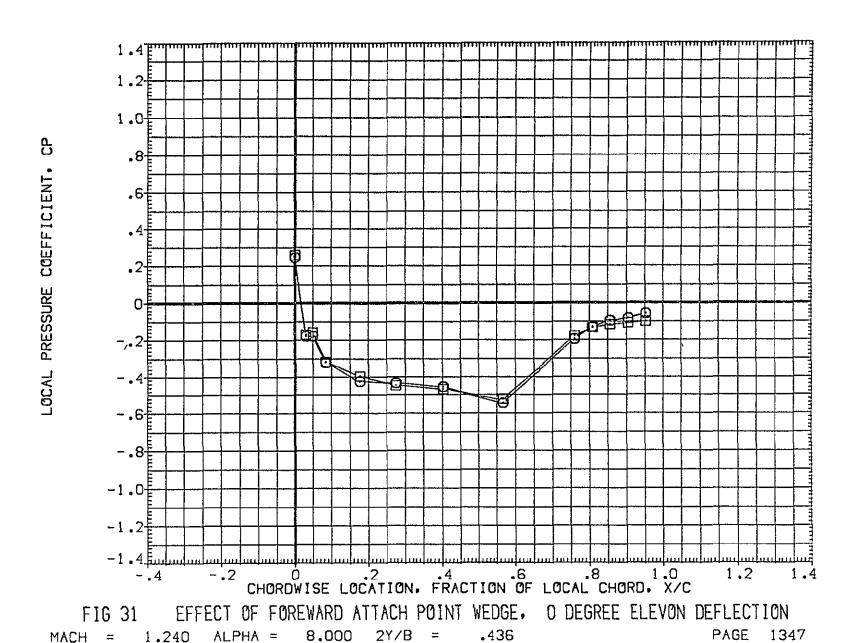


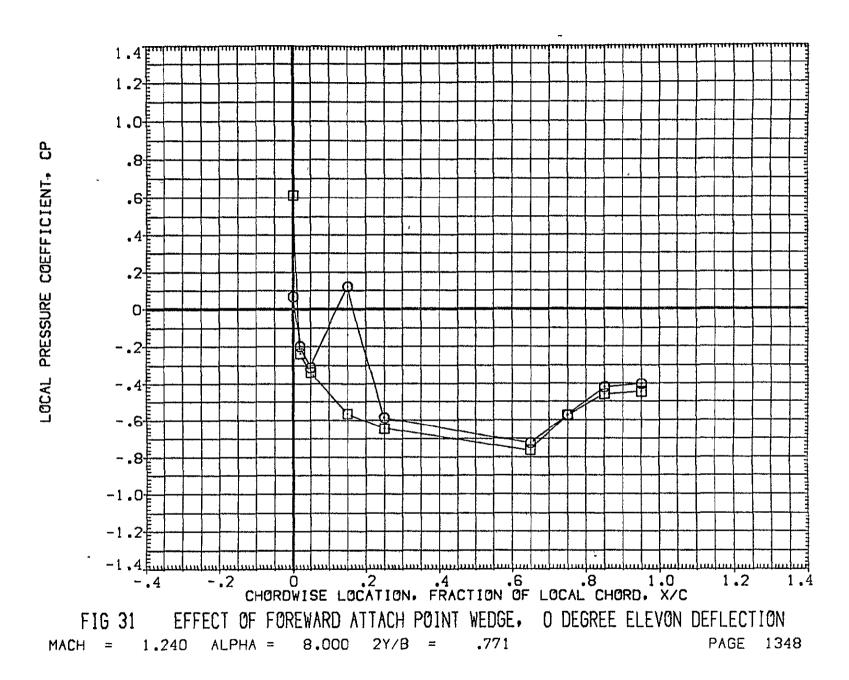


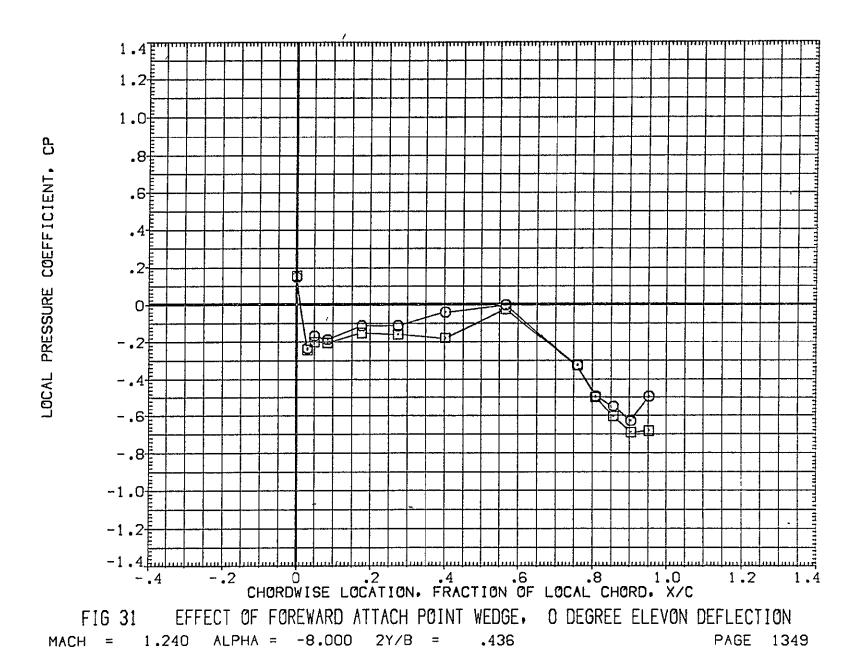


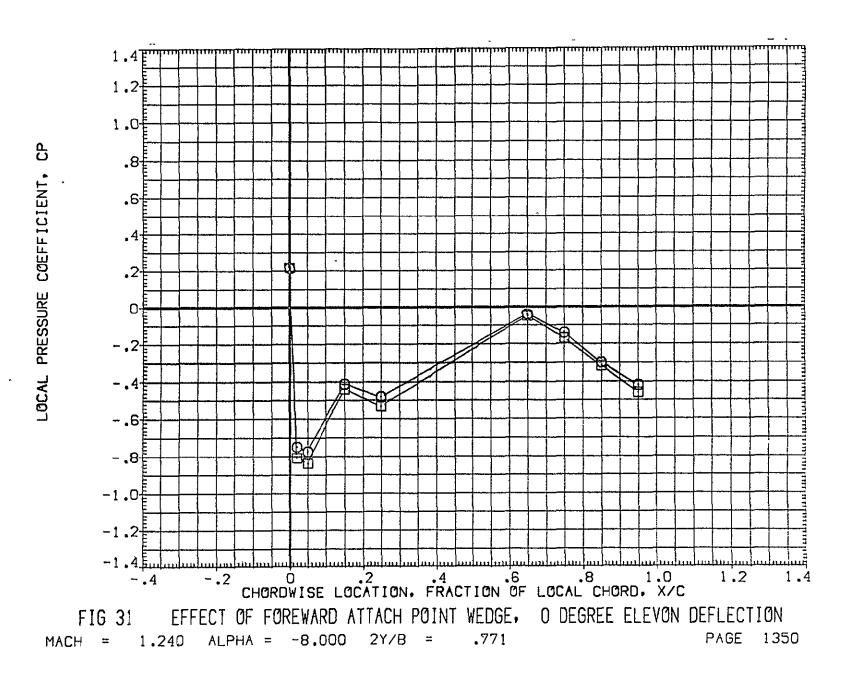




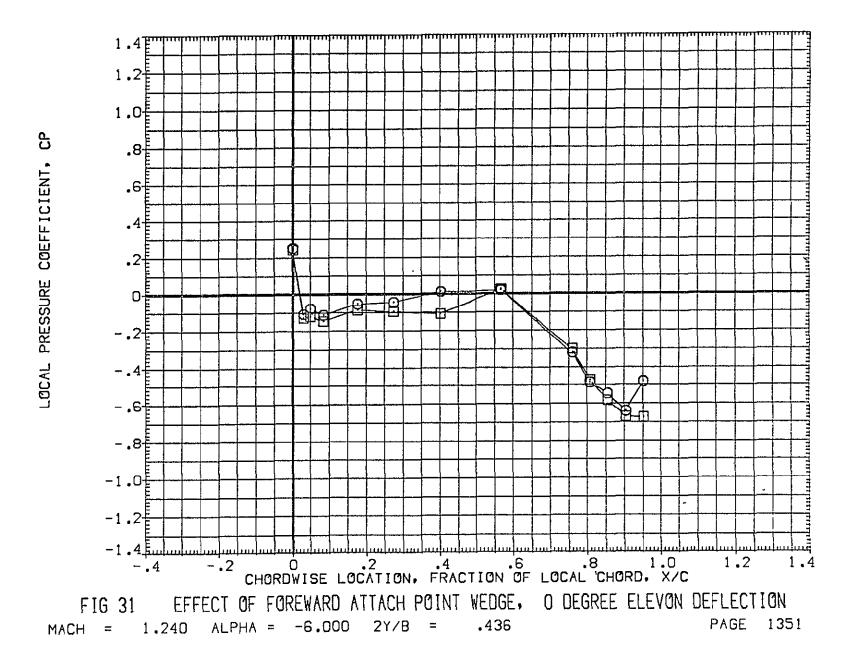






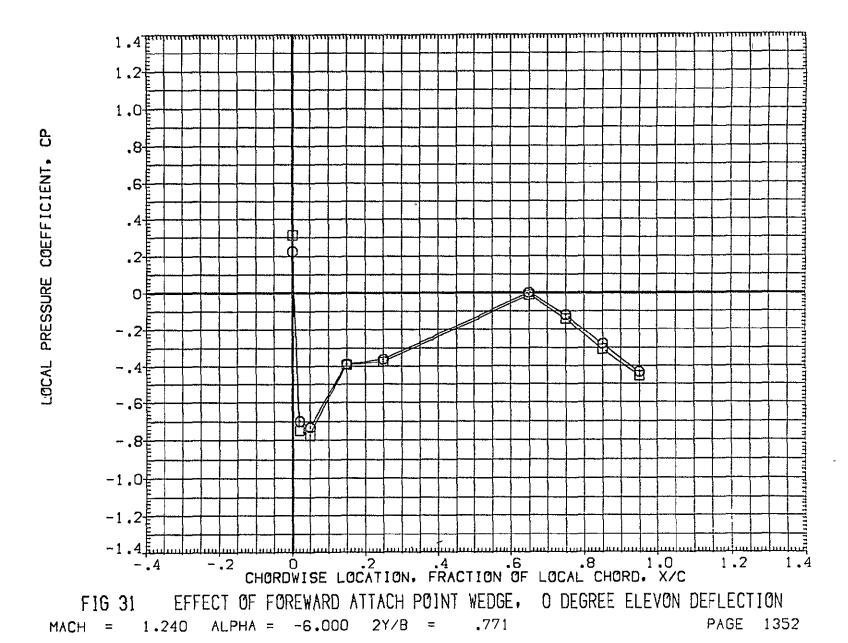


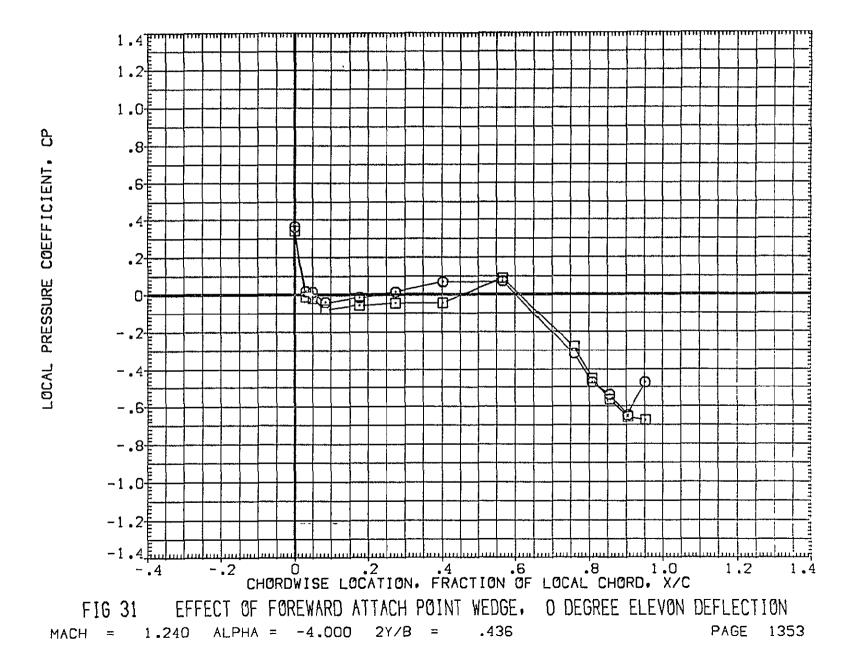
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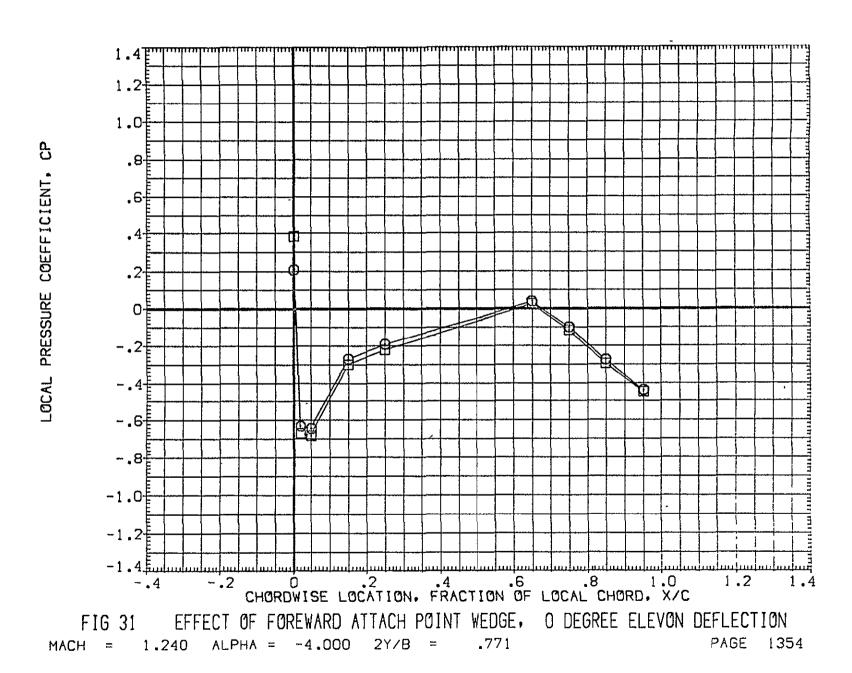


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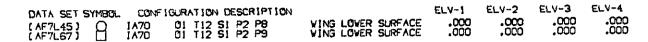
ON ELV-1 ELV-2 ELV-3 ELV-4
VING LOVER SURFACE .000 .000 .000 .000
VING LOWER SURFACE .000 .000 .000 .000

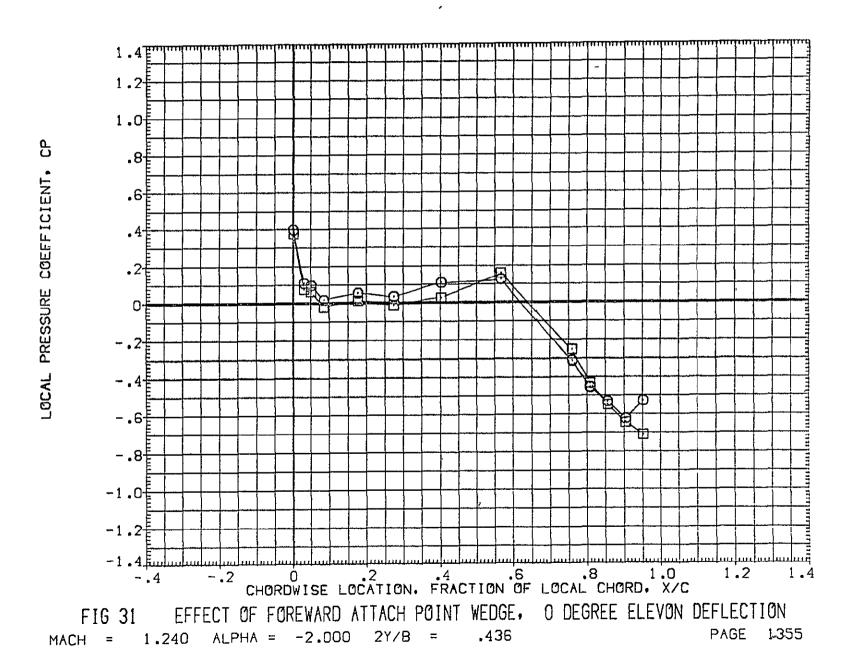


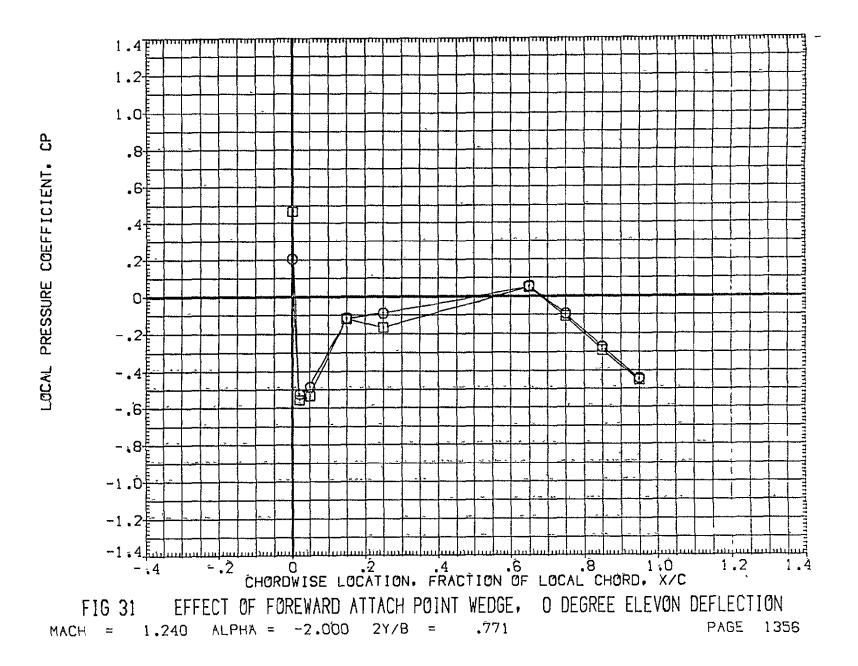




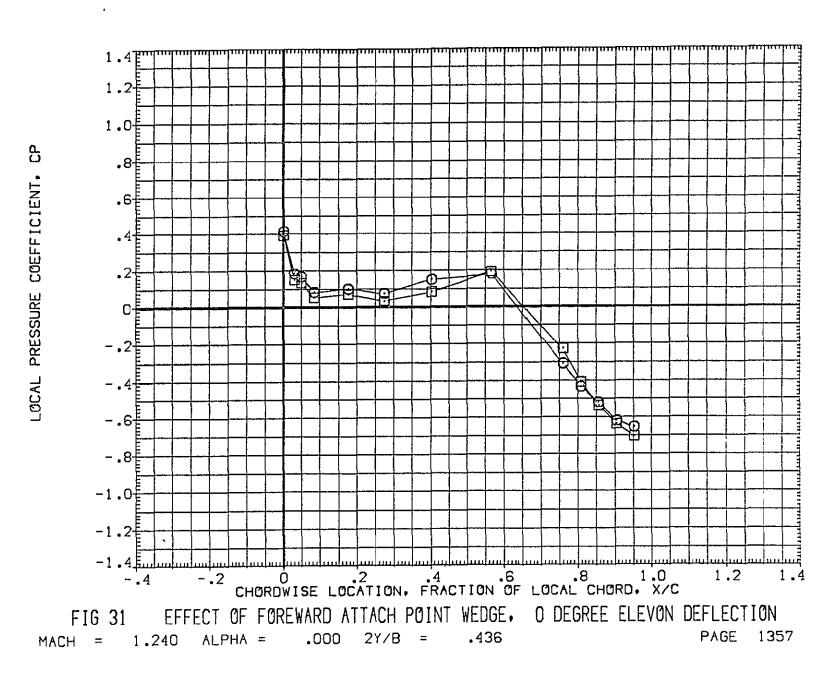
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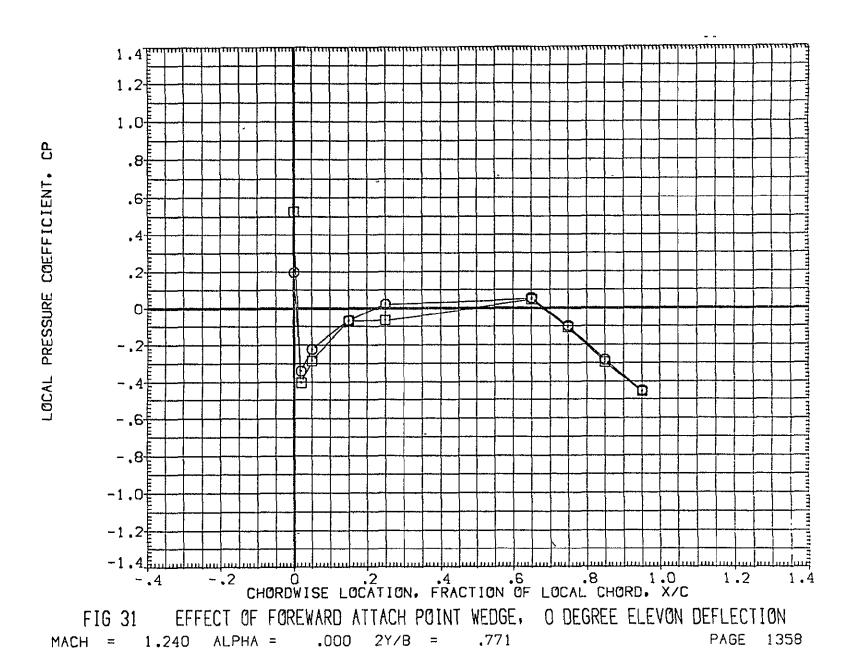


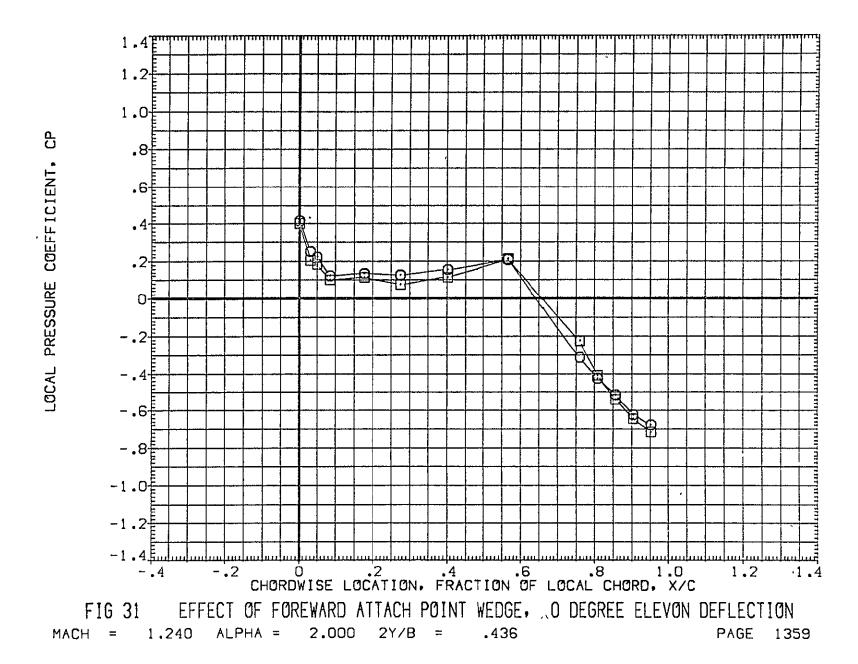


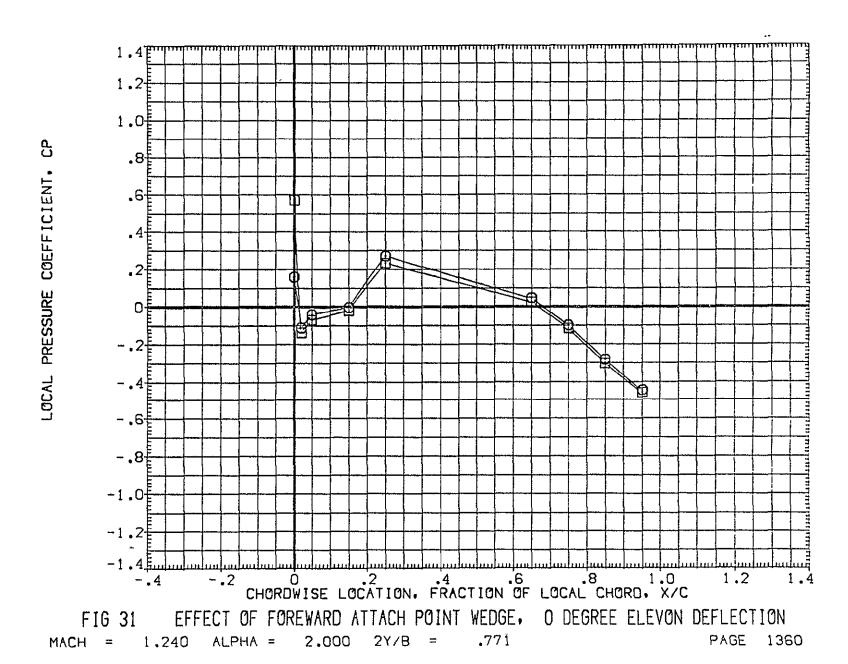


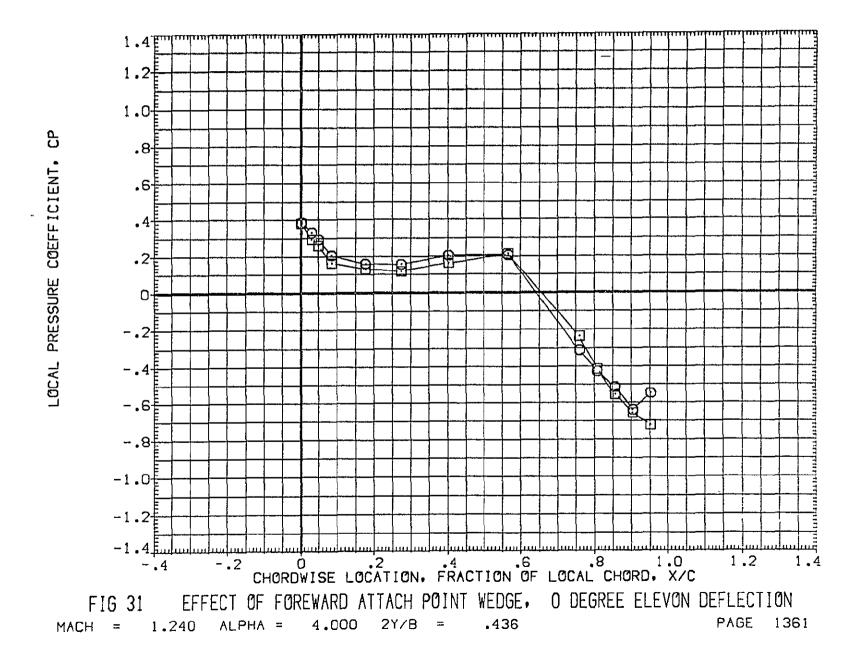


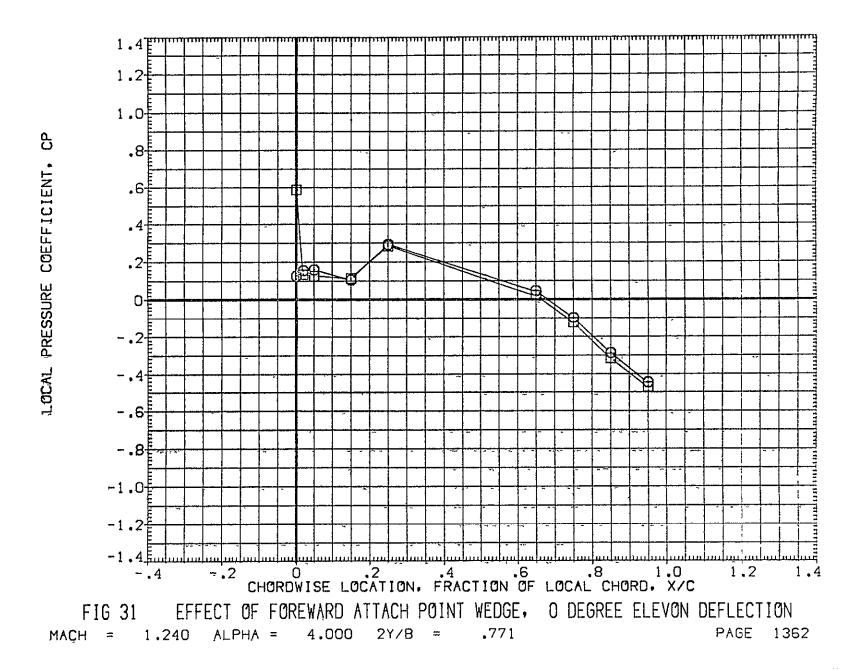


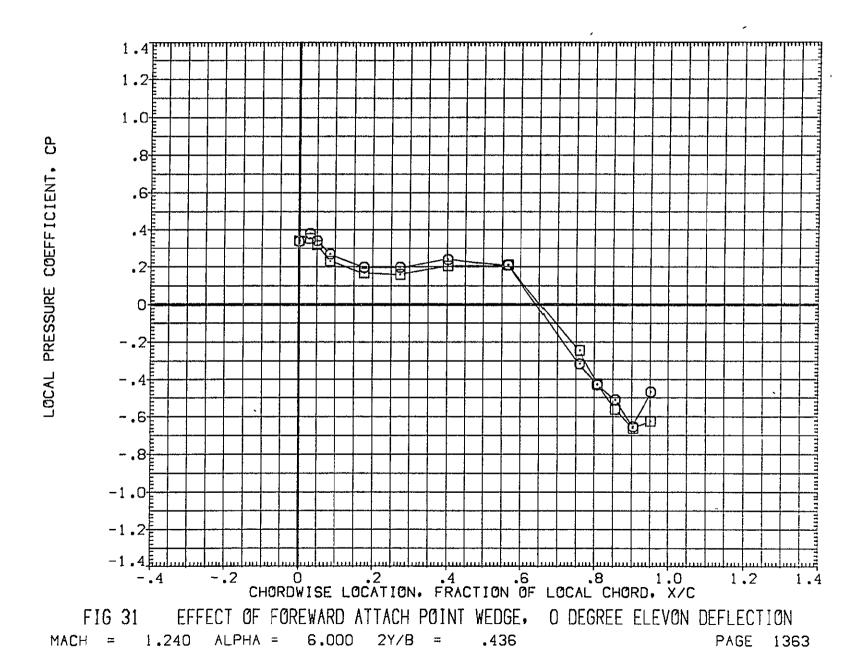


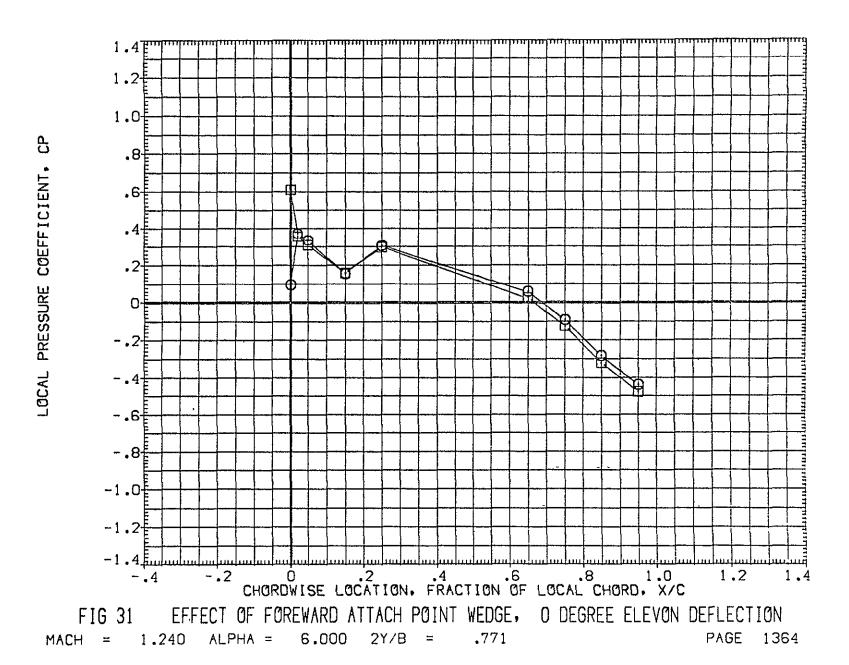


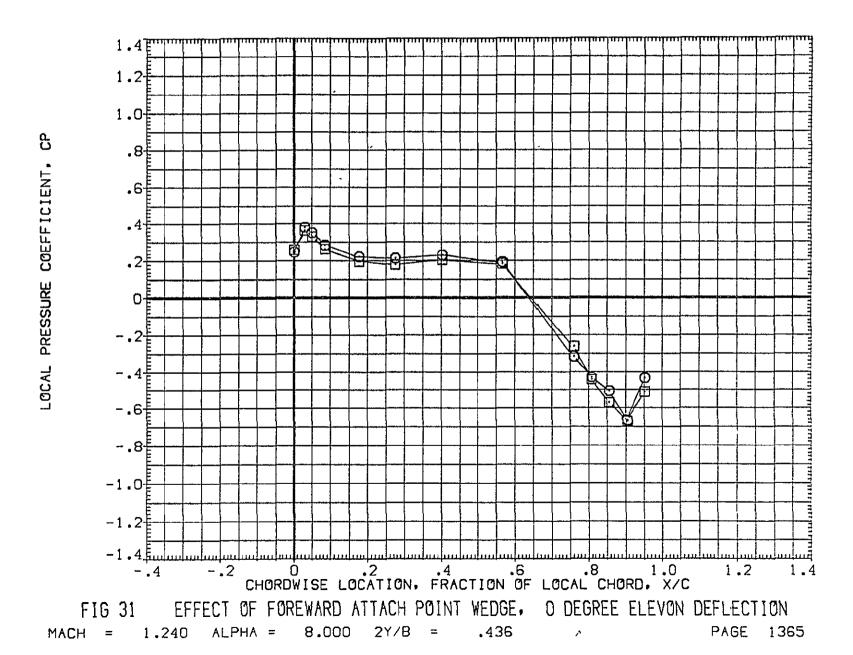


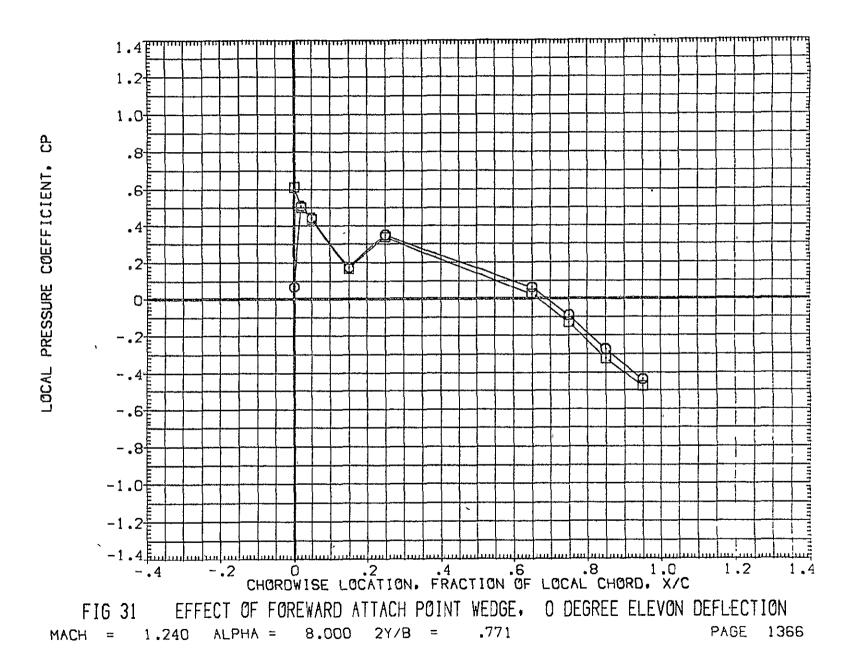


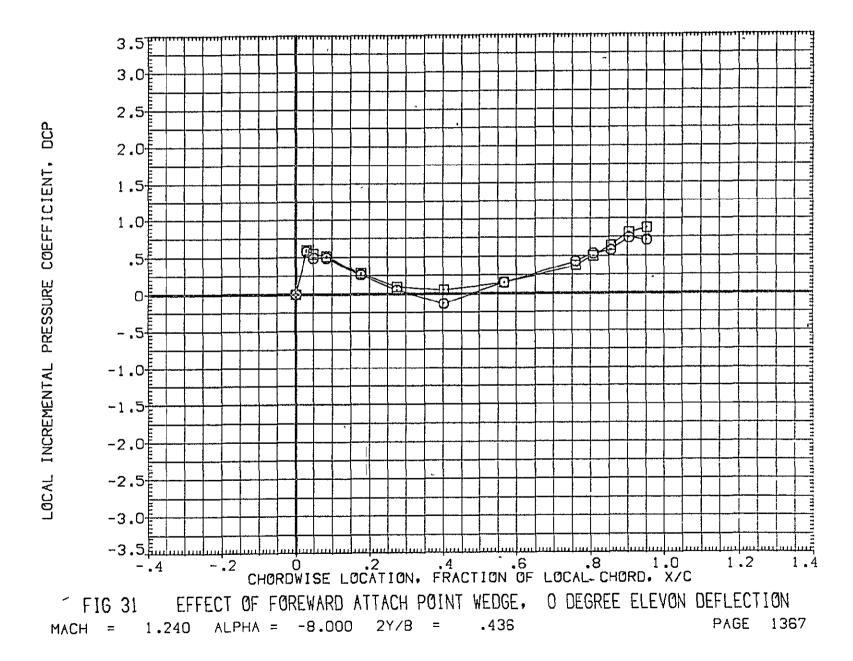


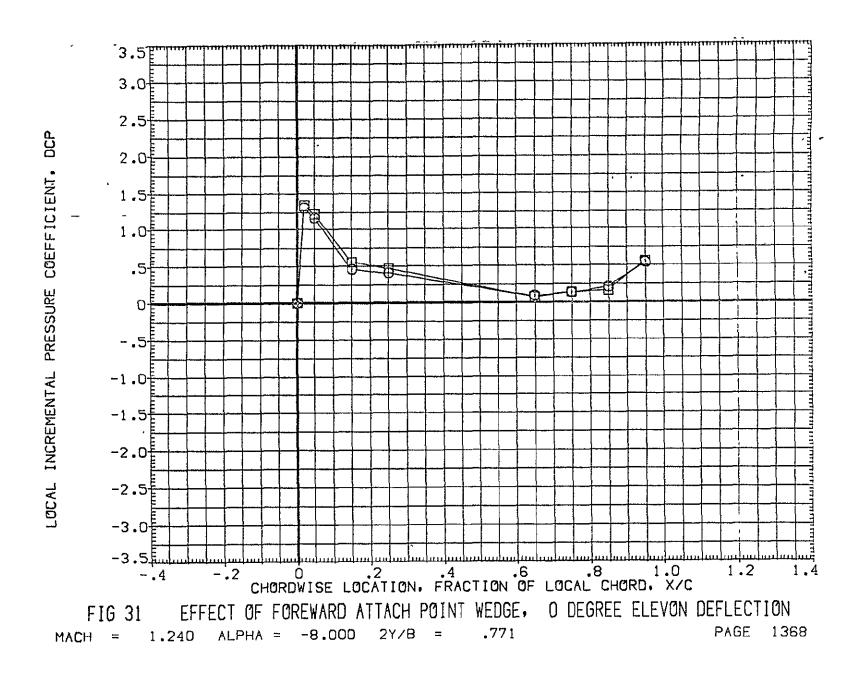


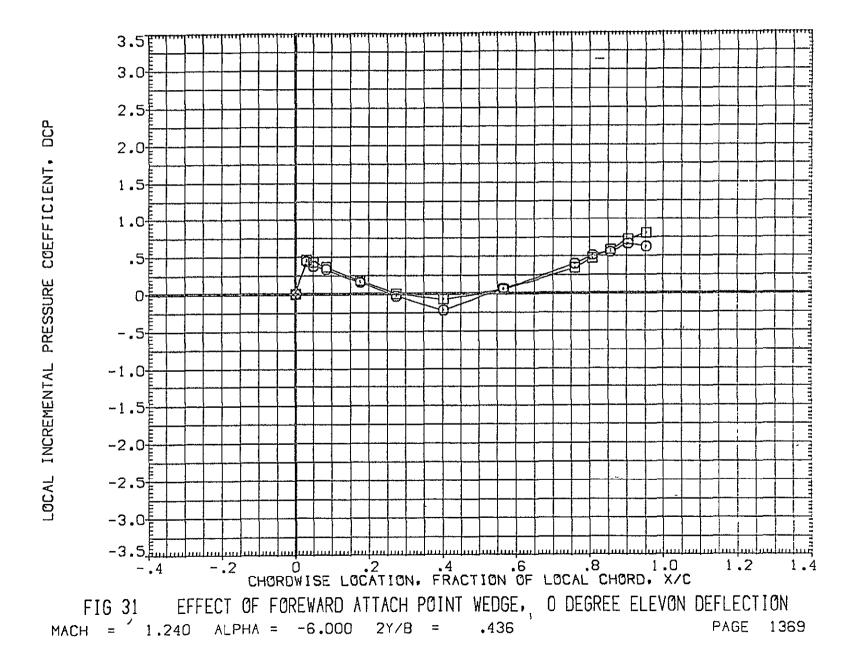


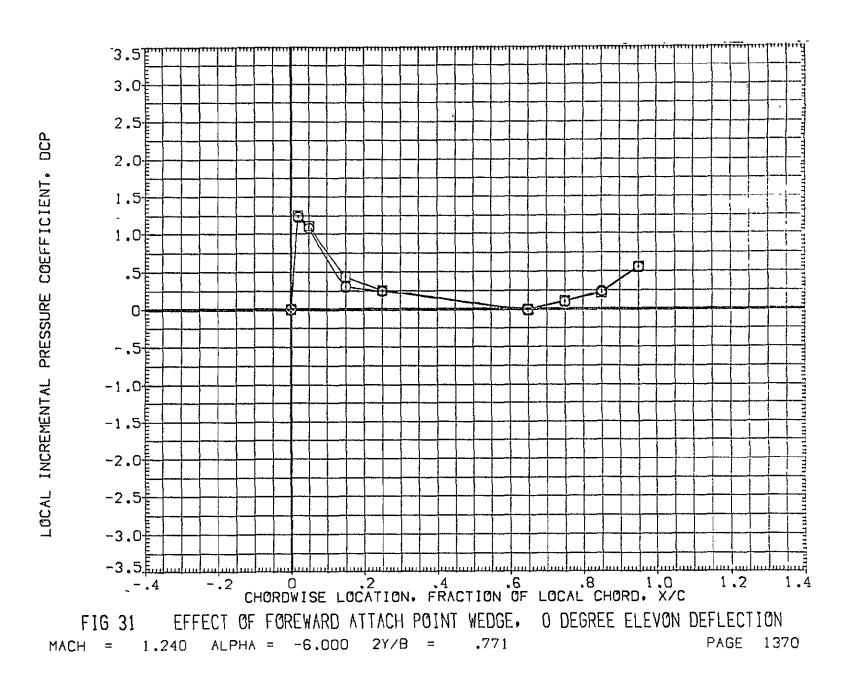


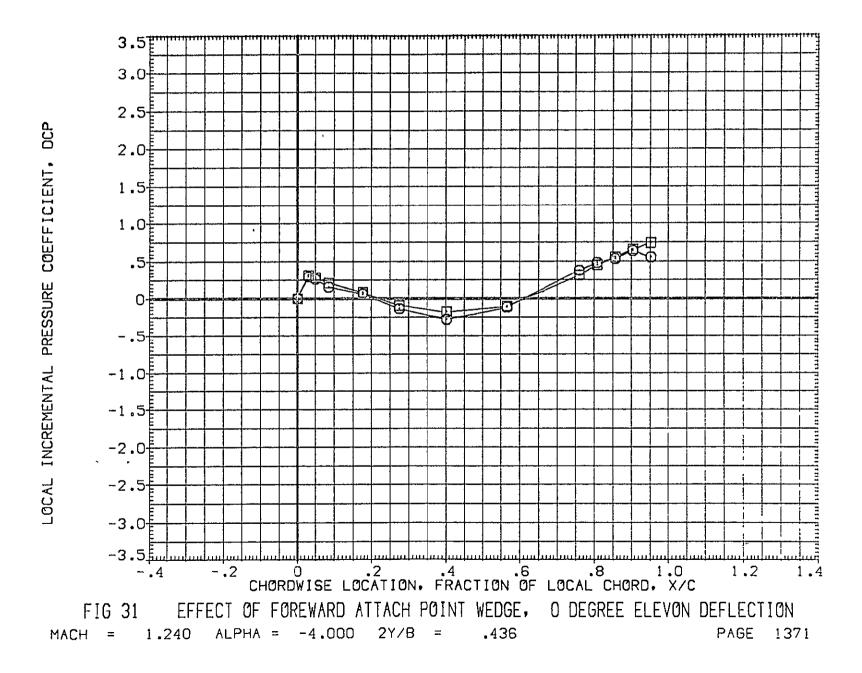


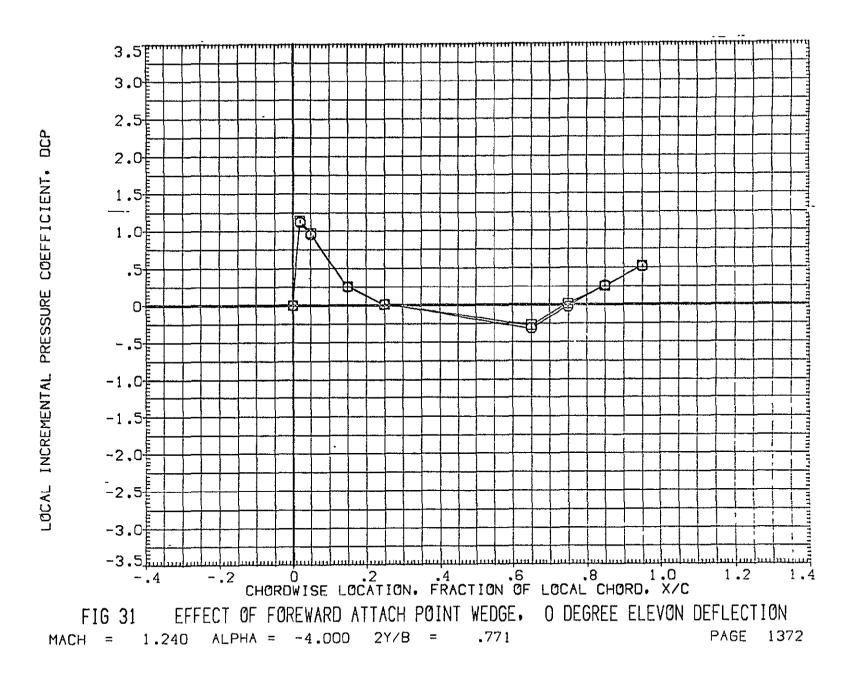


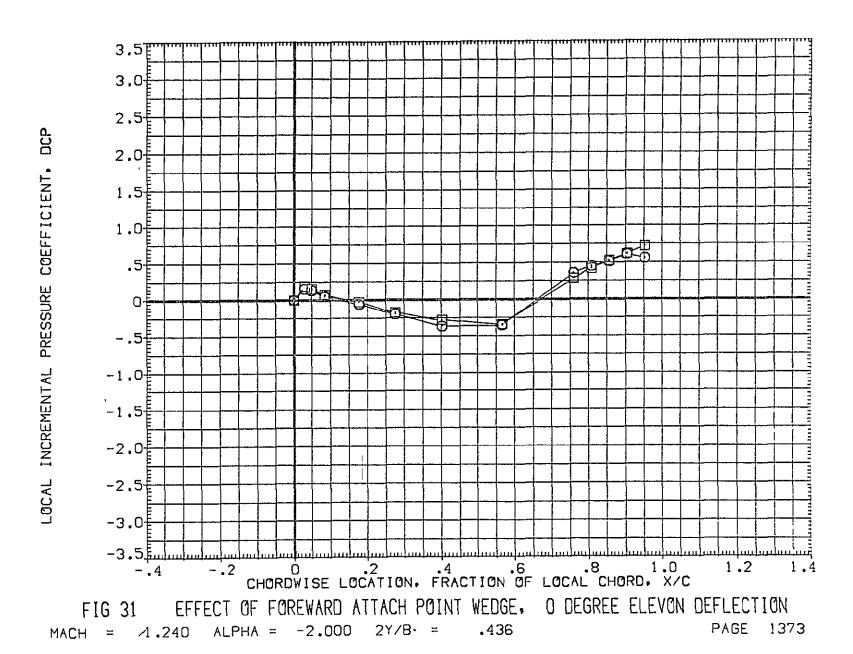


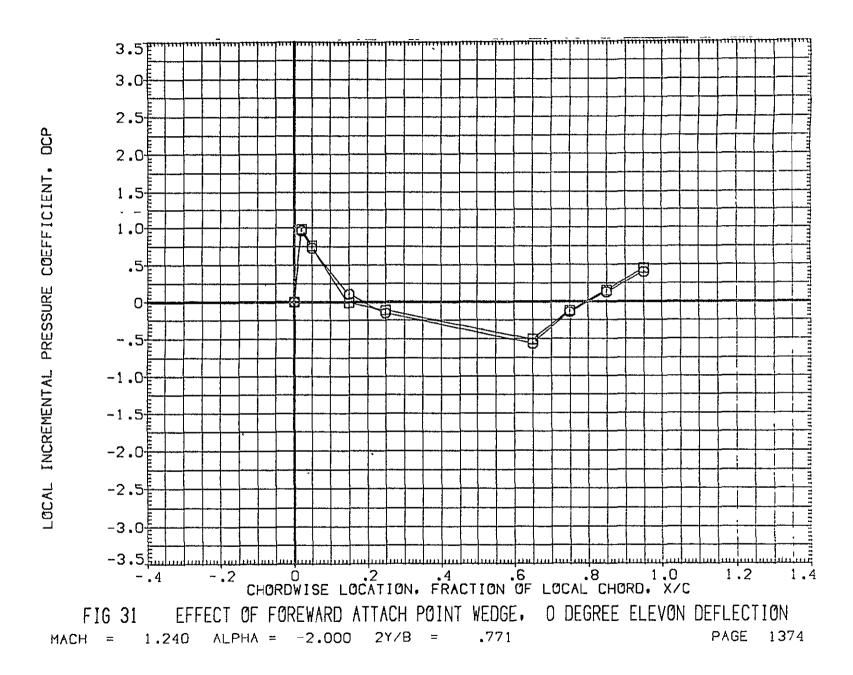


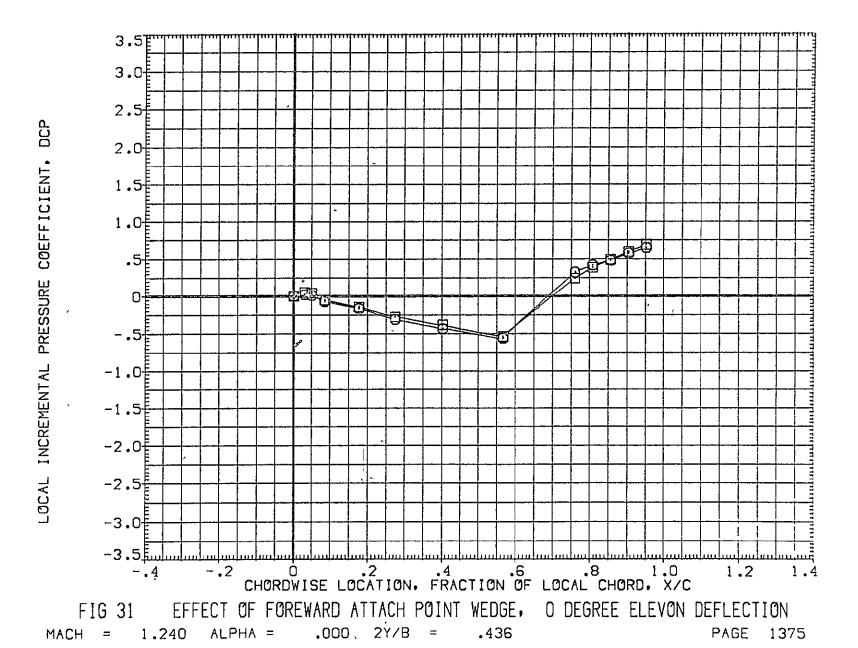


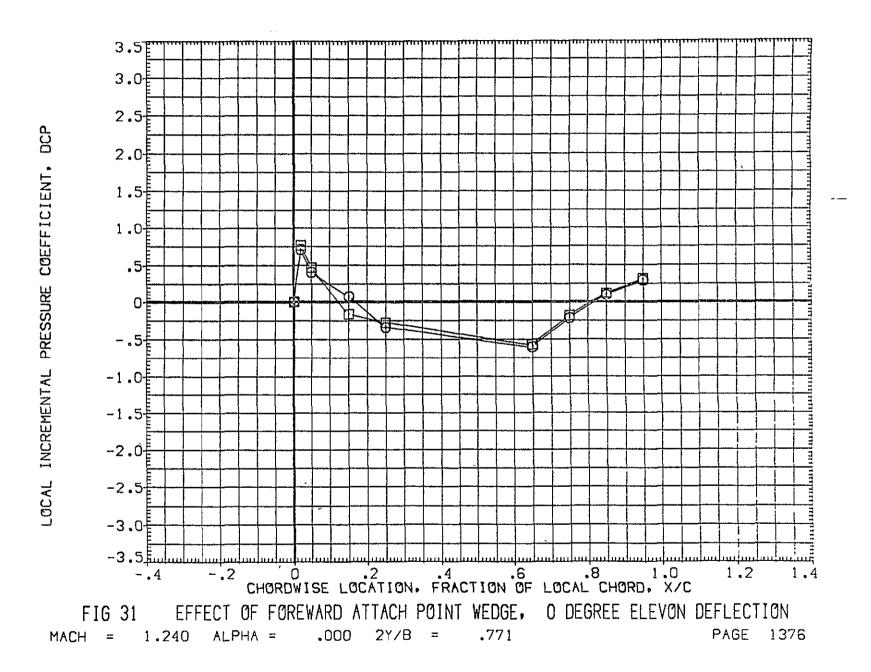


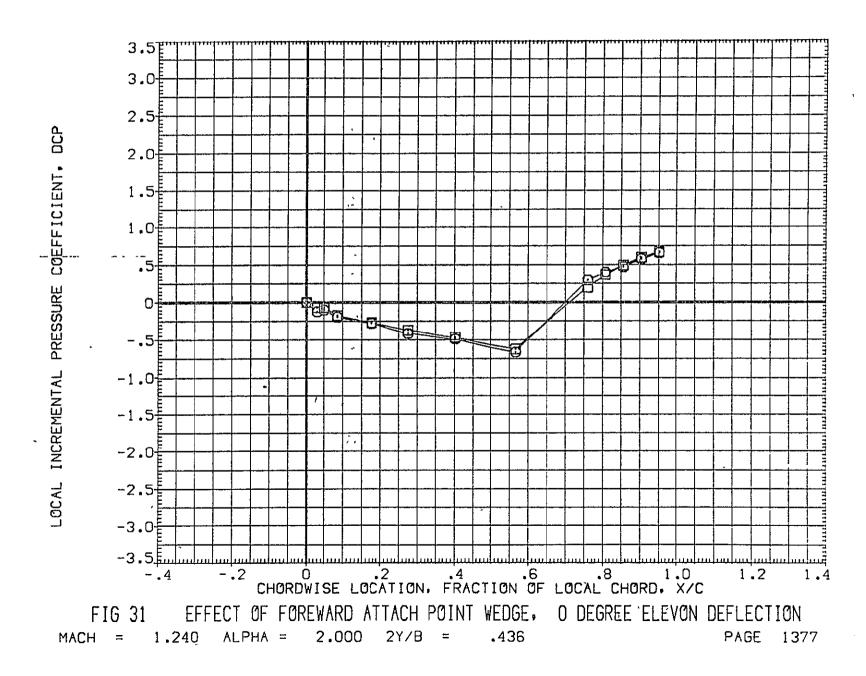


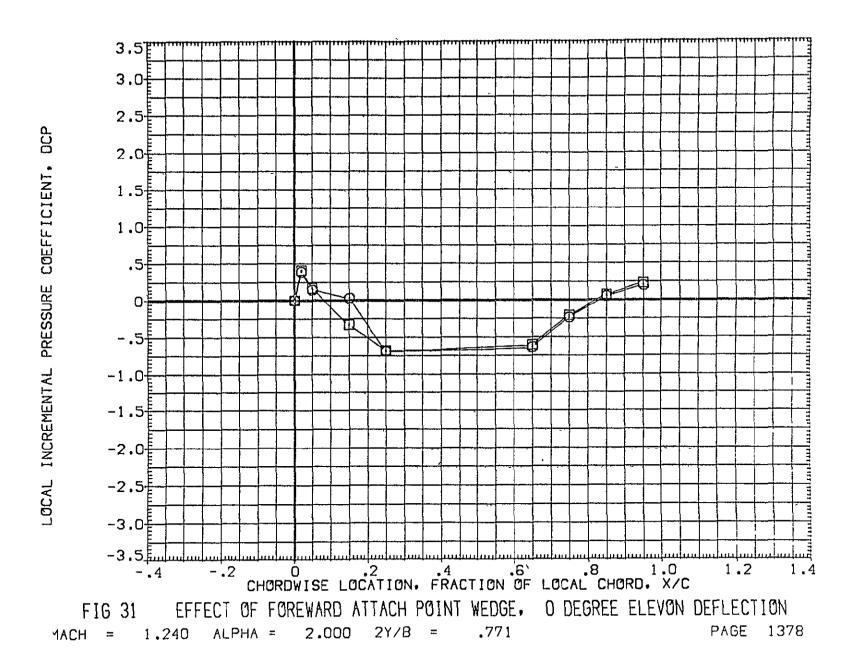


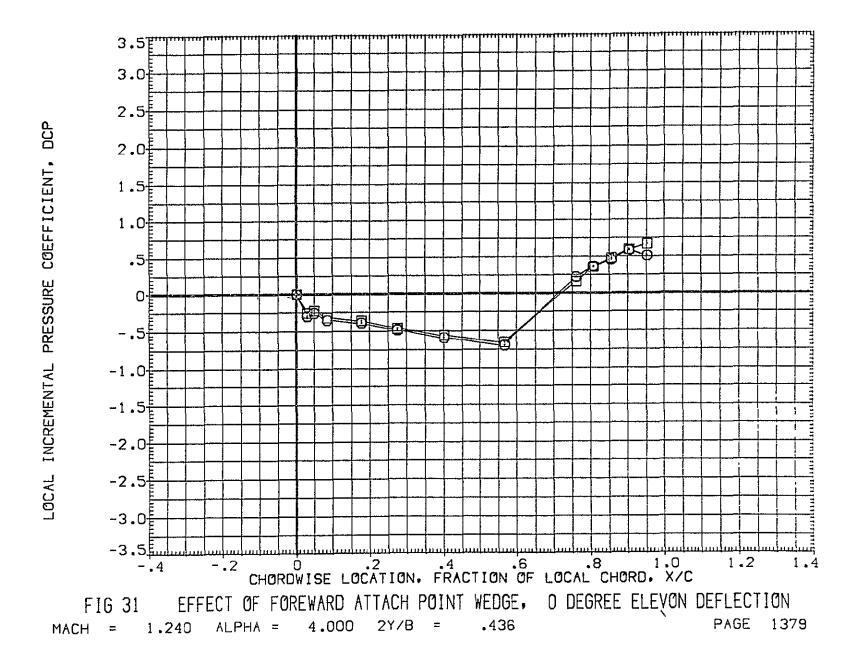


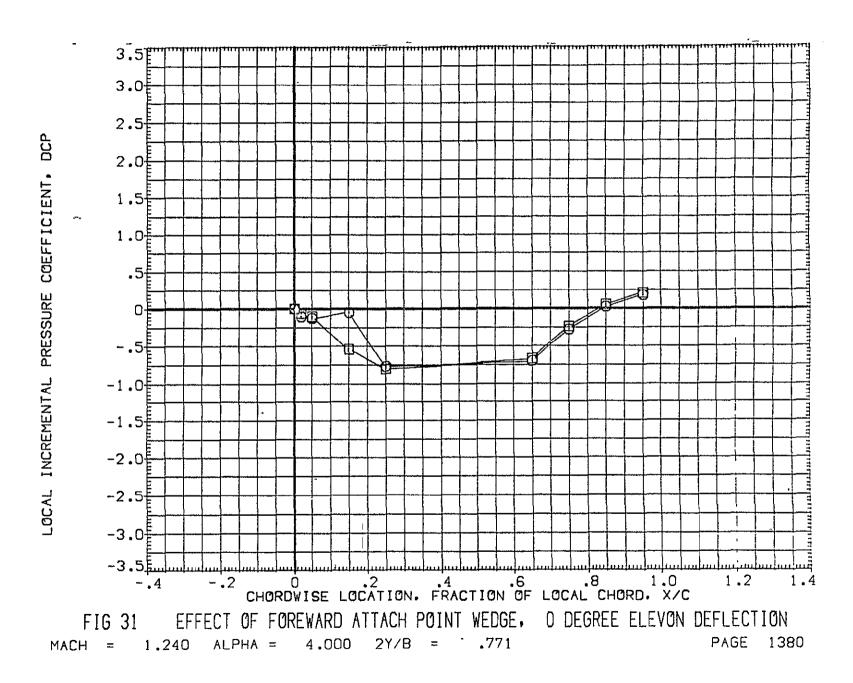


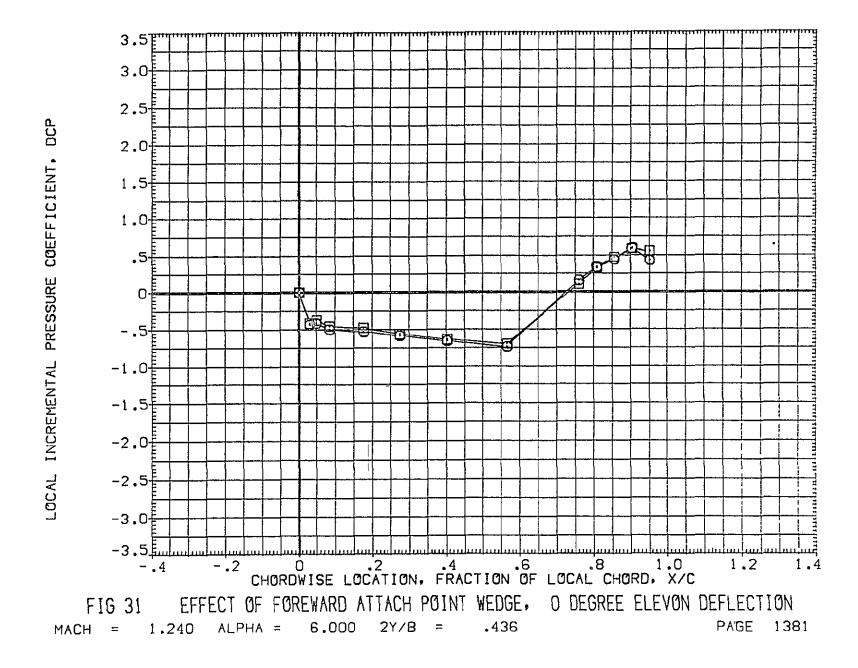


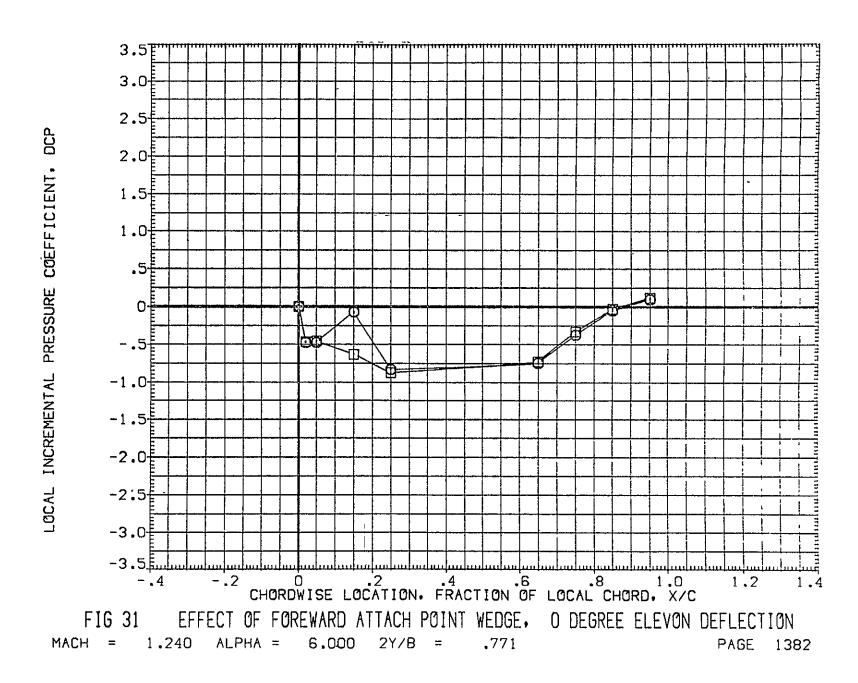


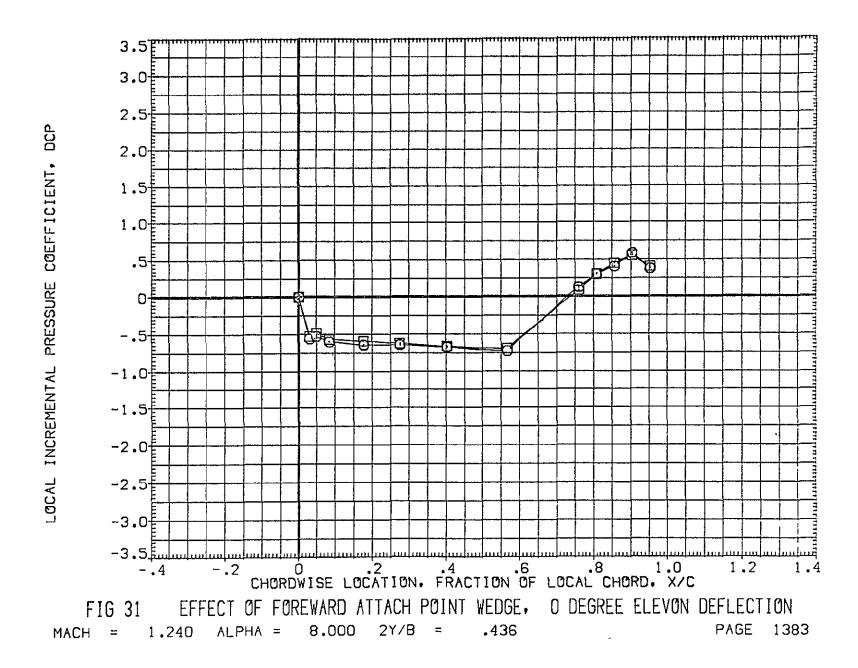


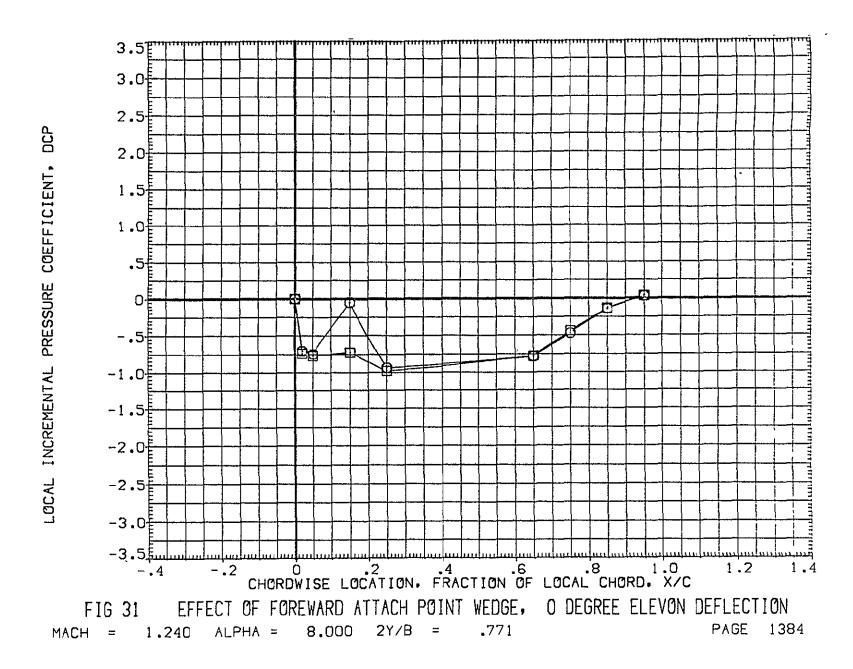


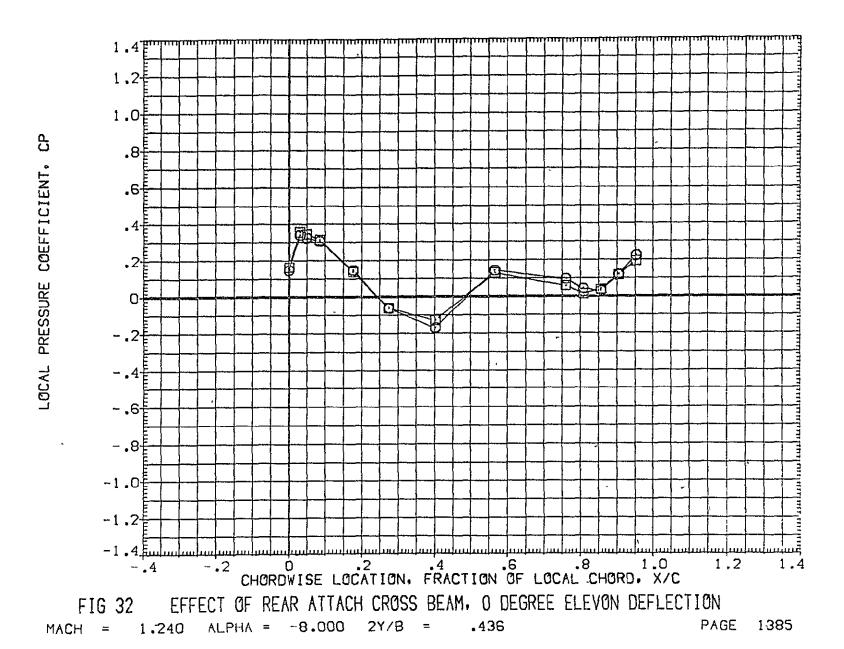


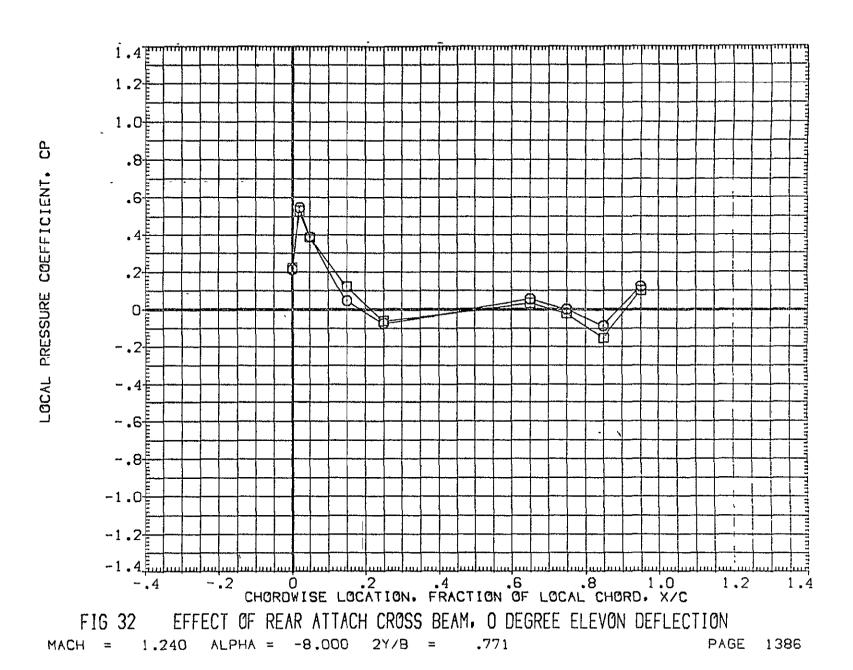










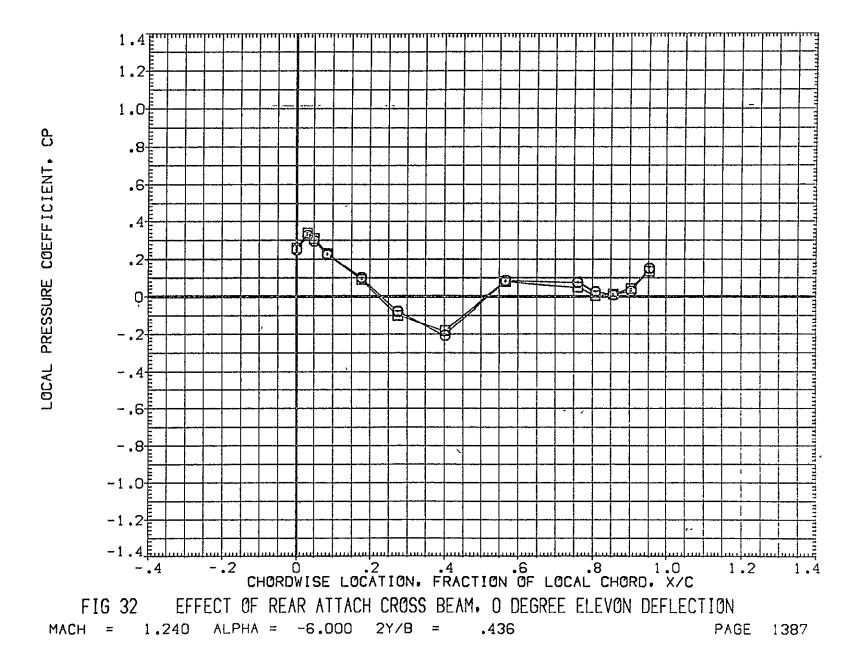


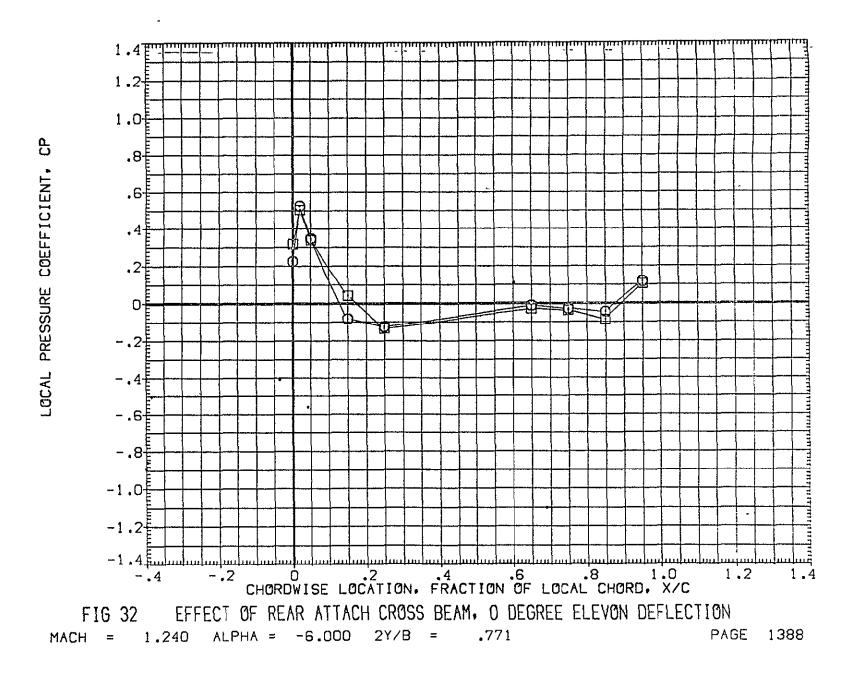
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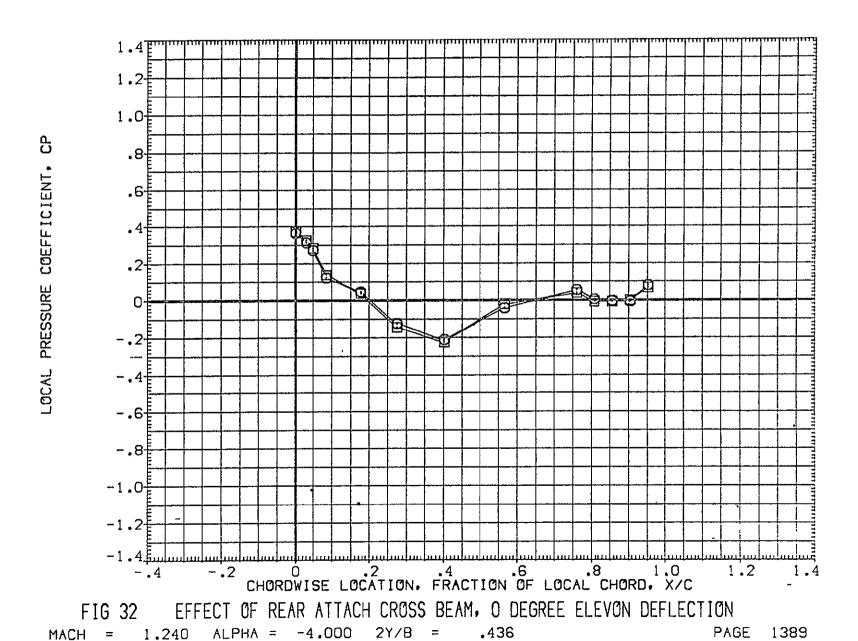
ELV-3 ELV-4

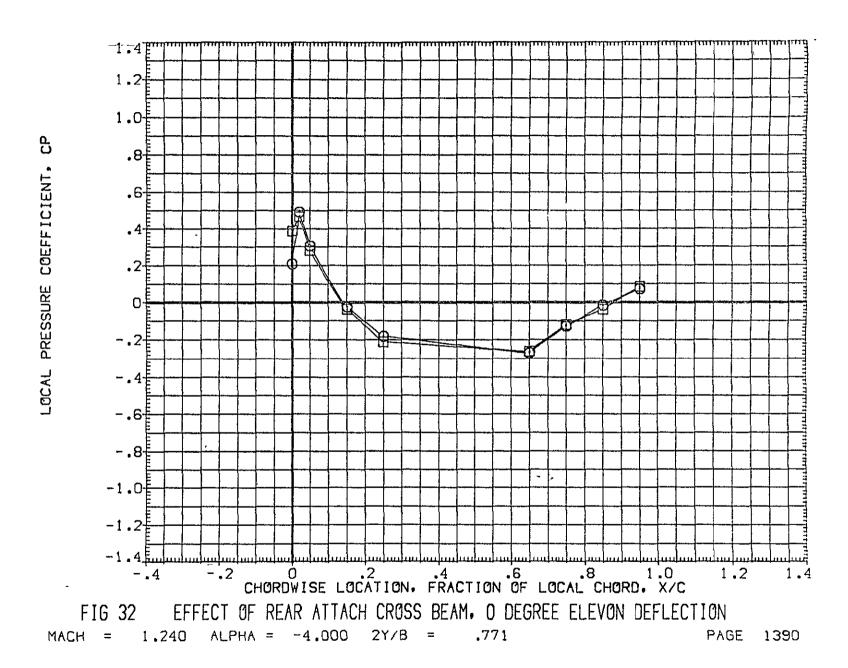
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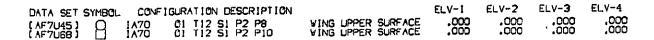
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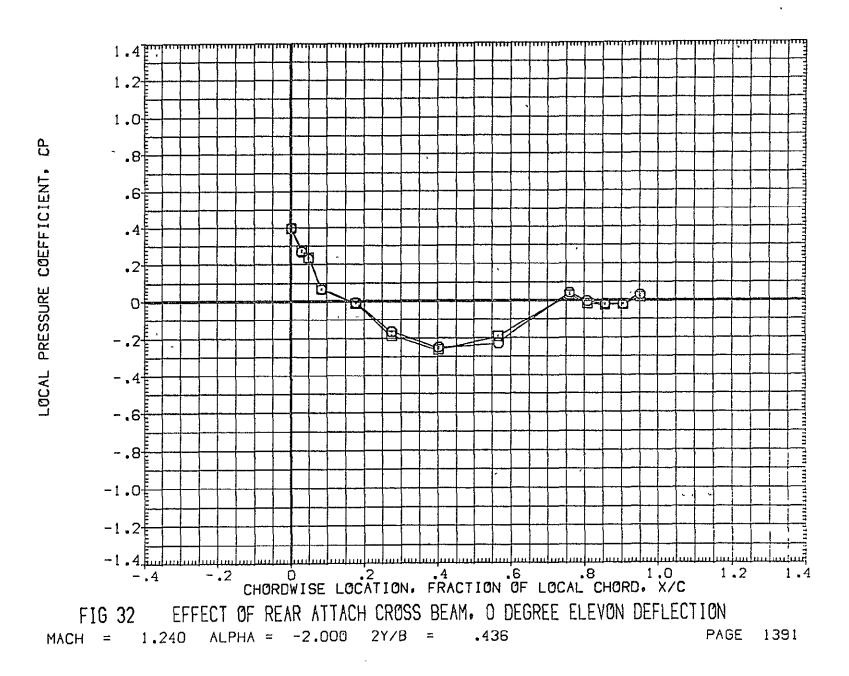












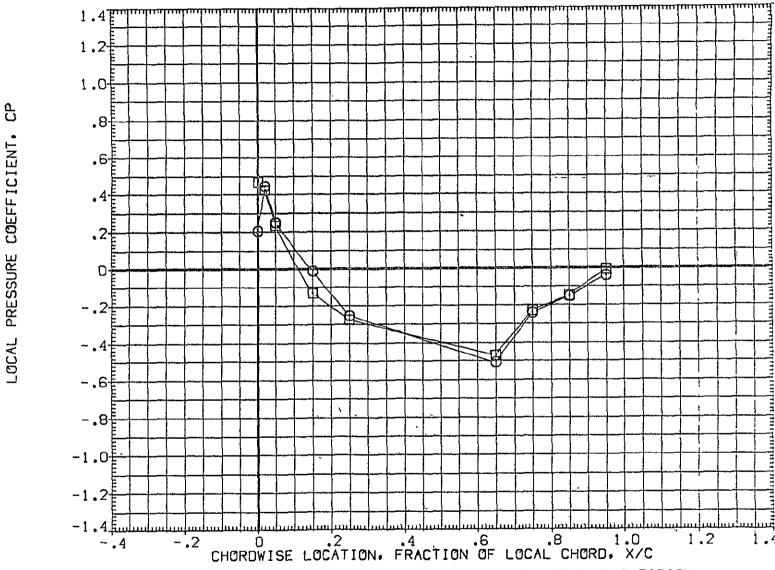
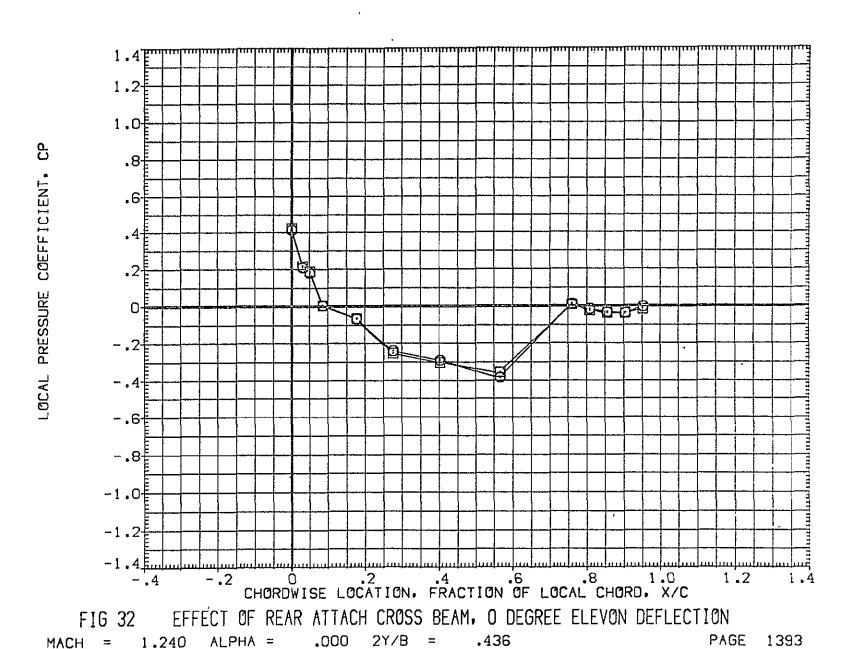
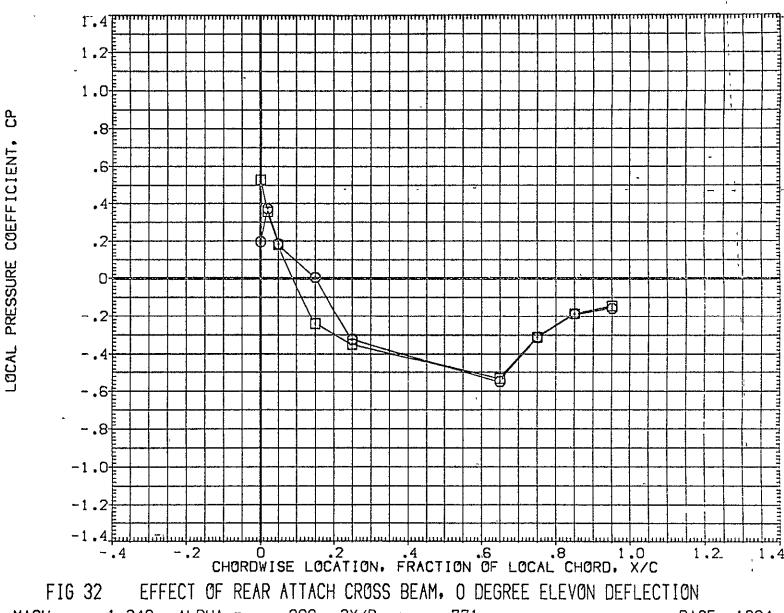


FIG 32 EFFECT OF REAR ATTACH CROSS BEAM. O DEGREE ELEVON DEFLECTION

MACH = 1.240 ALPHA = -2.000 2Y/B = .771 PAGE 1392

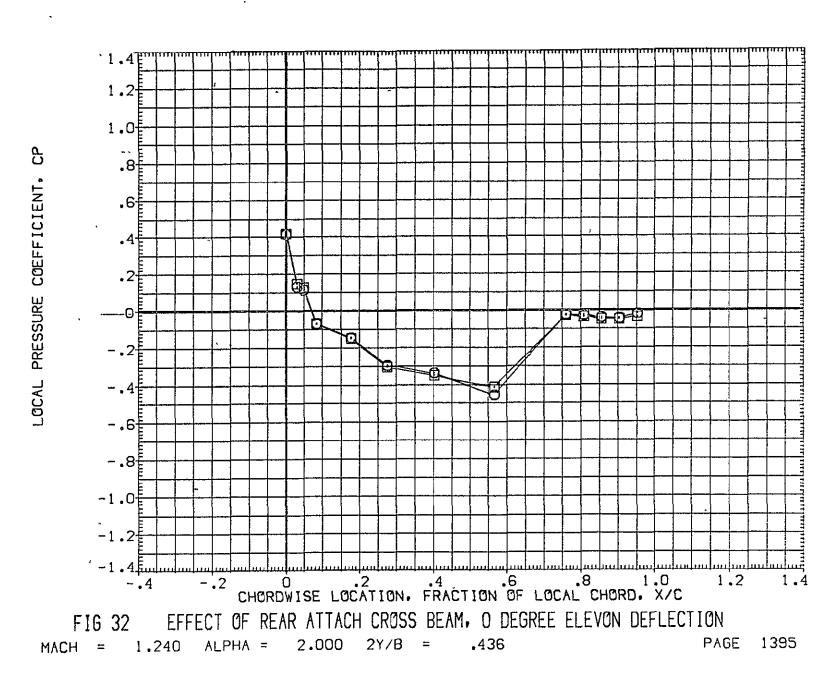


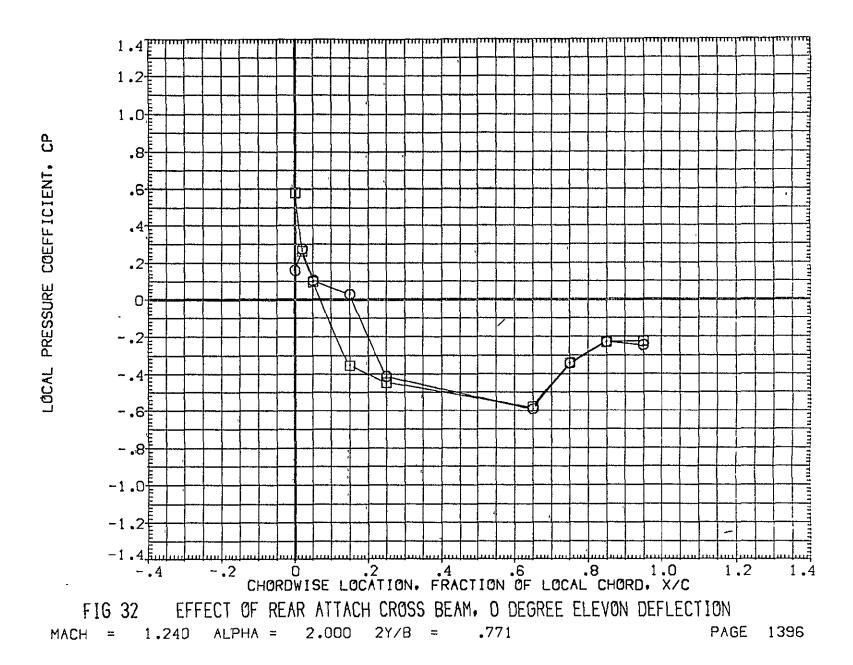


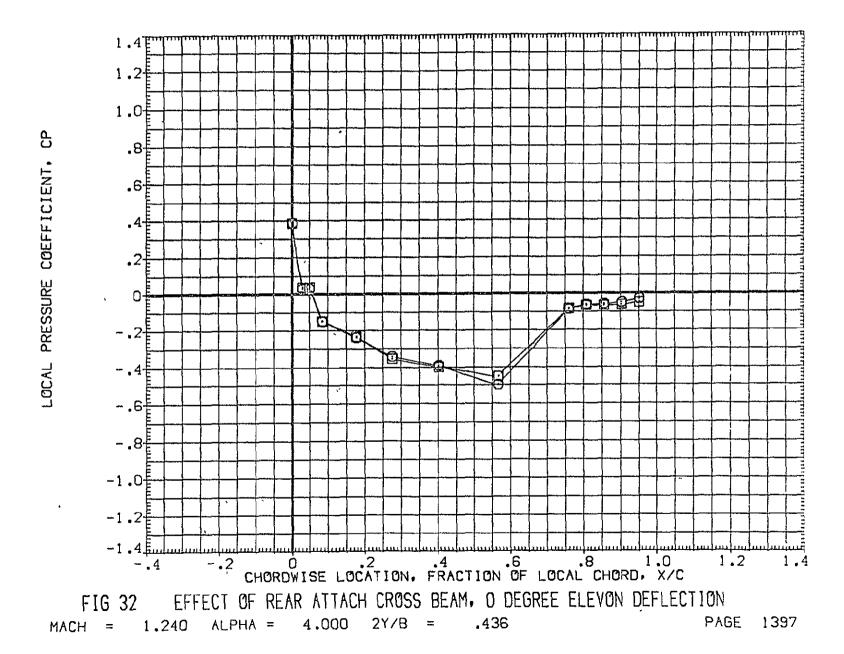


MACH = 1.240 ALPHA = .000 2Y/B = .771PAGE 1394

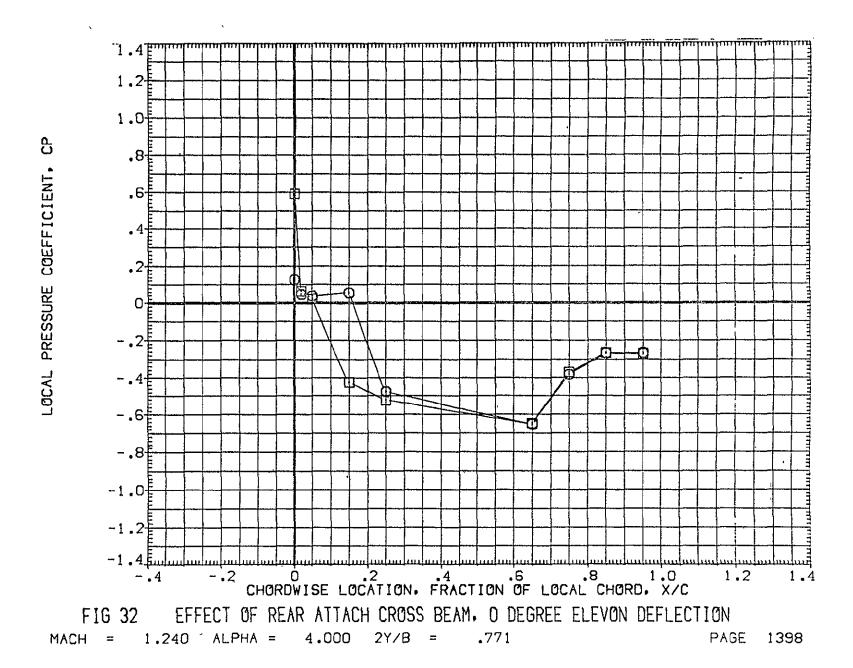




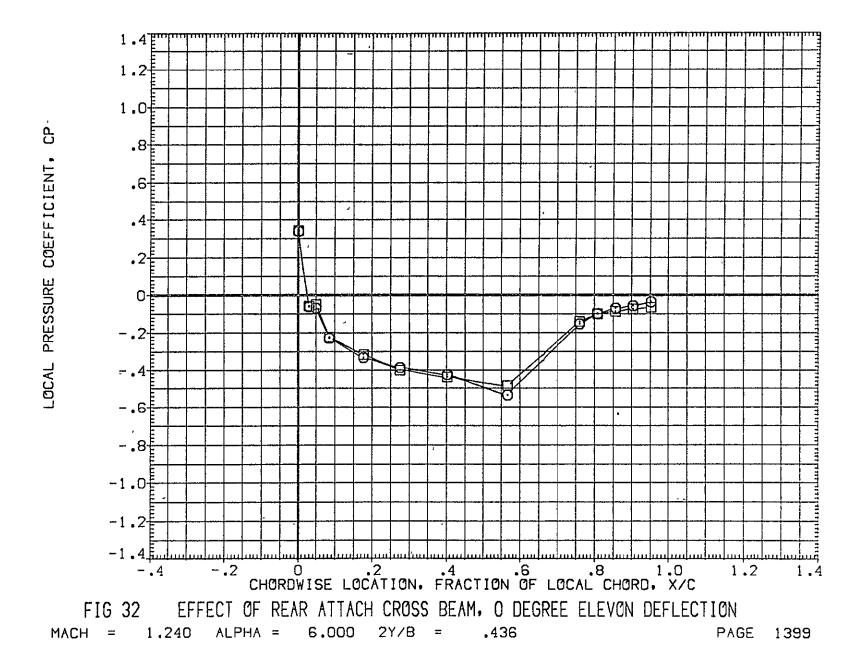


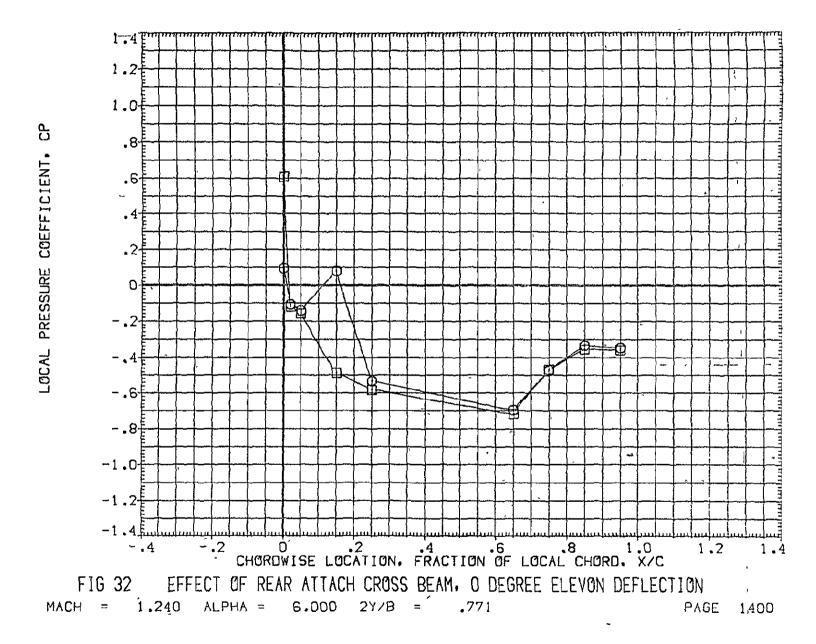




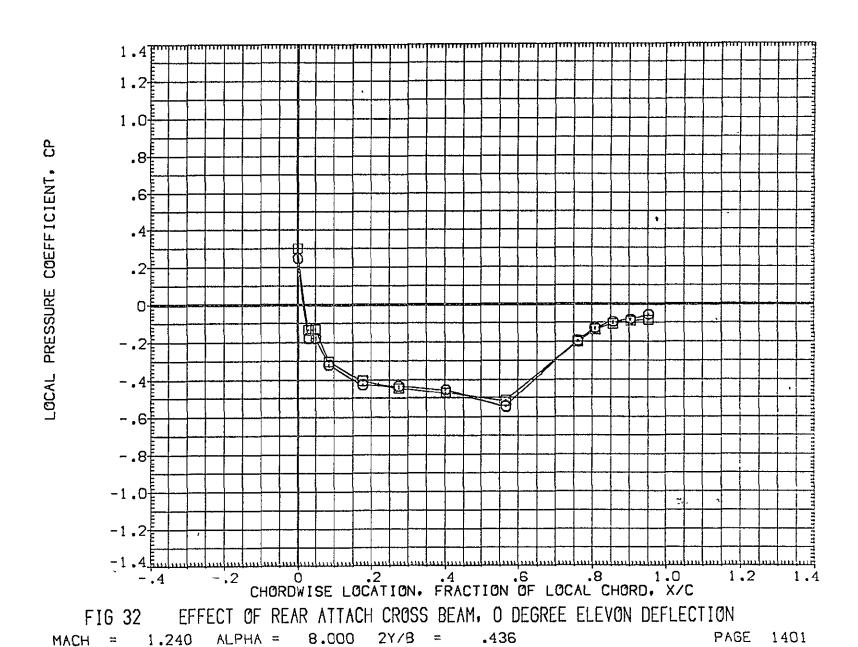




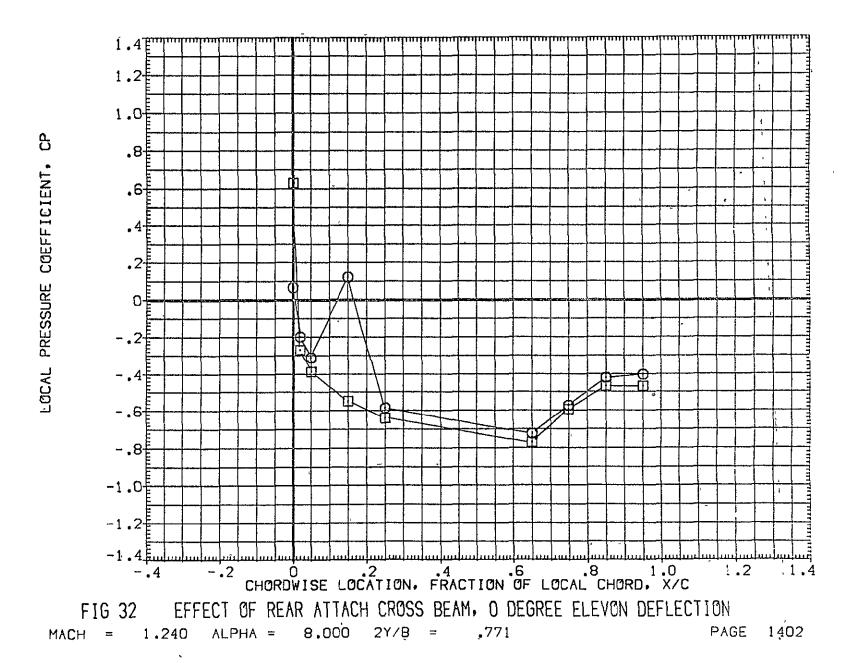




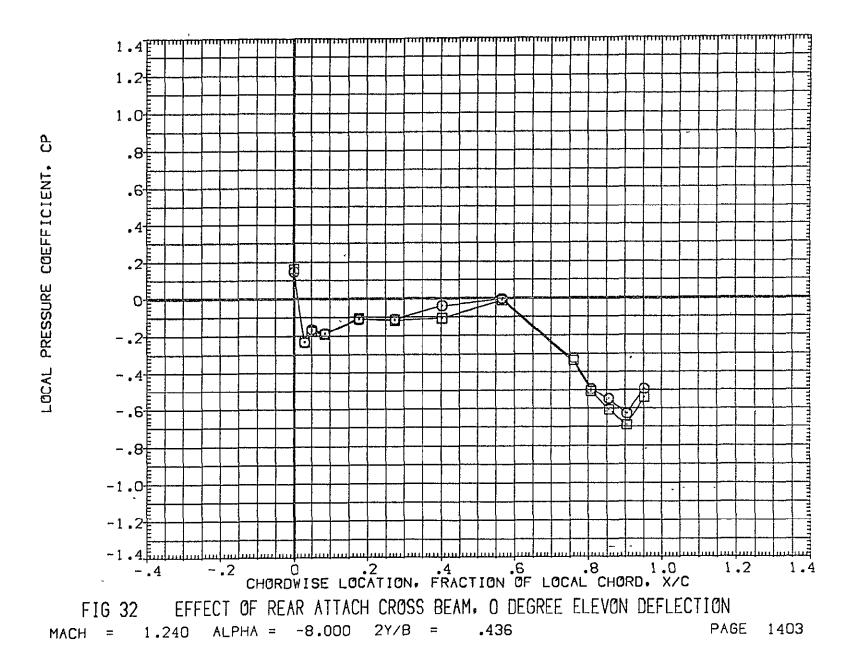
ELV-3 ELV-4

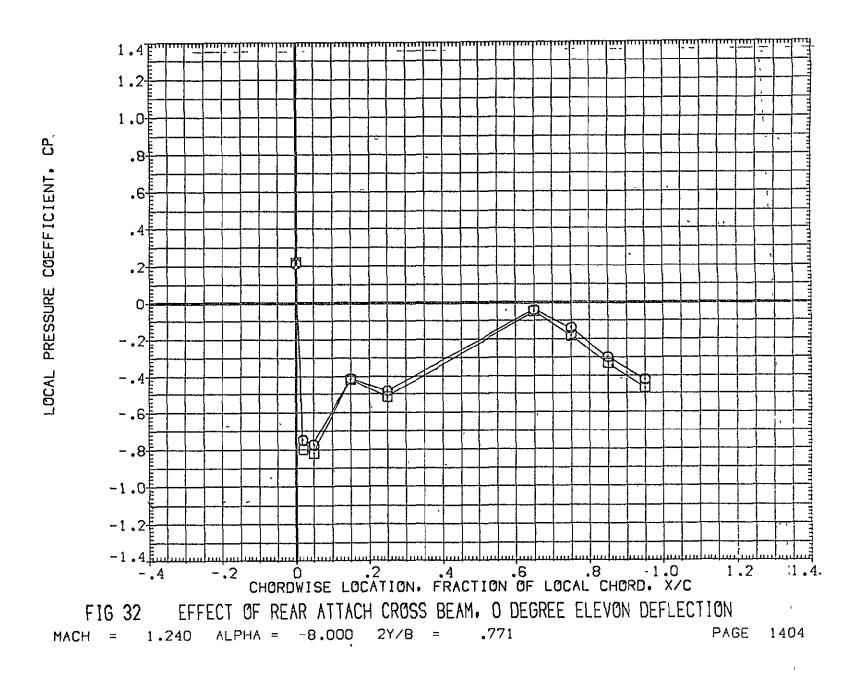


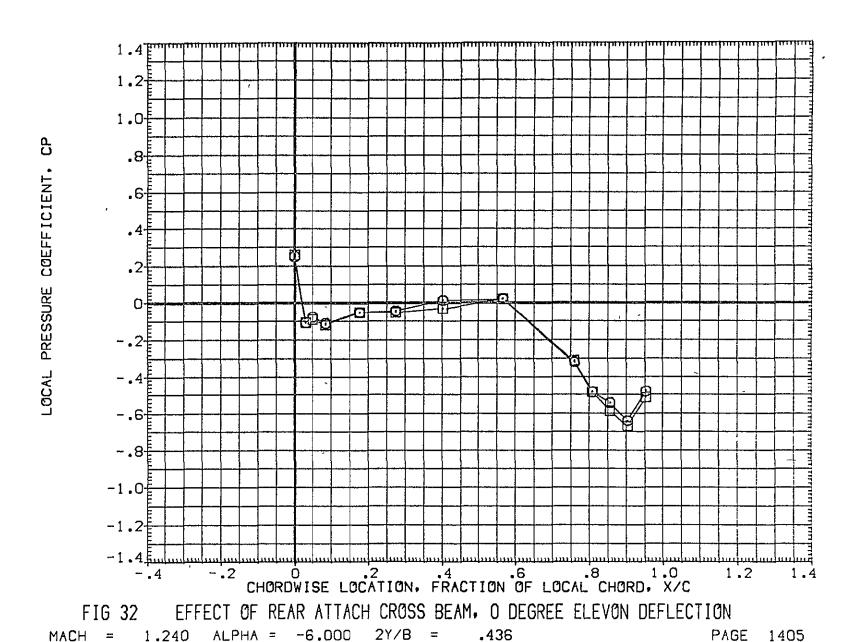
ELV-2 ELV-3 ELV-4

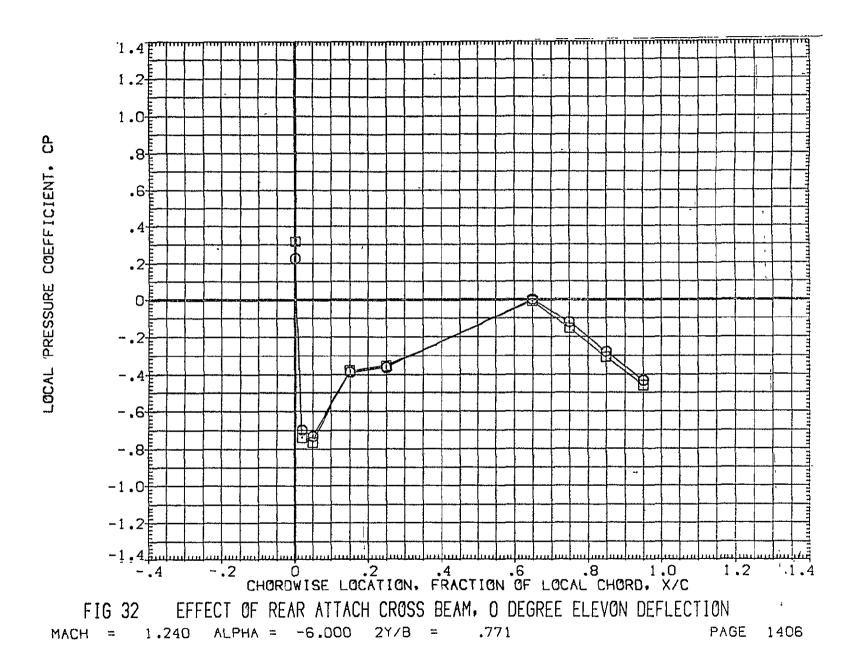


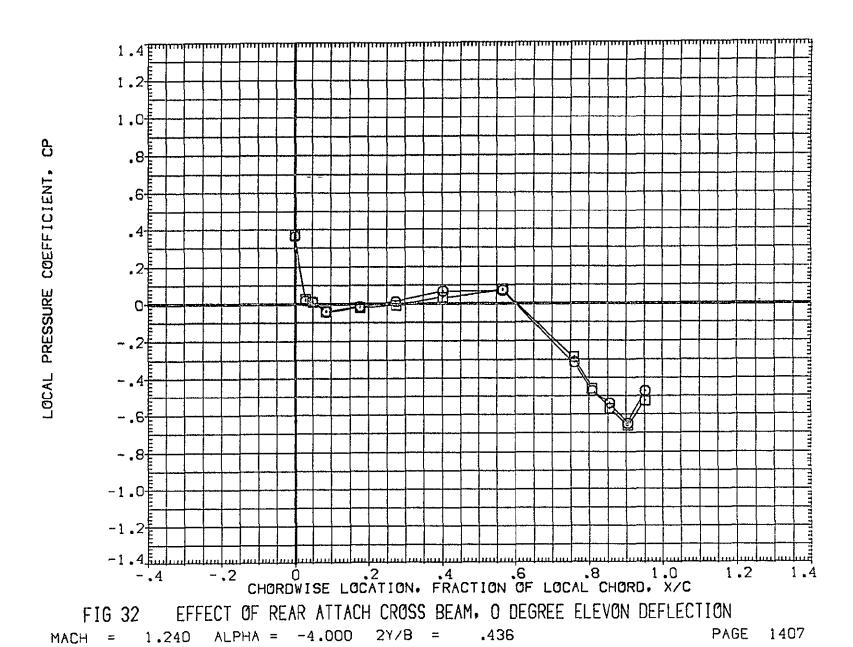
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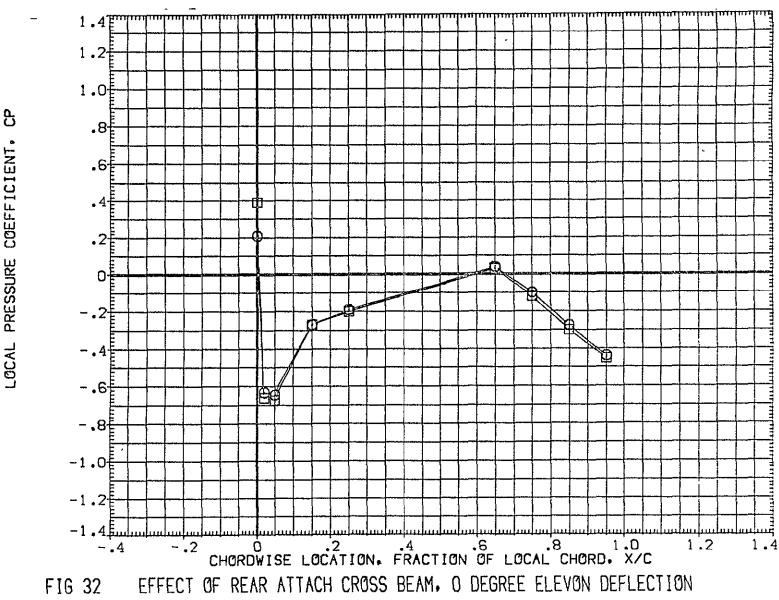






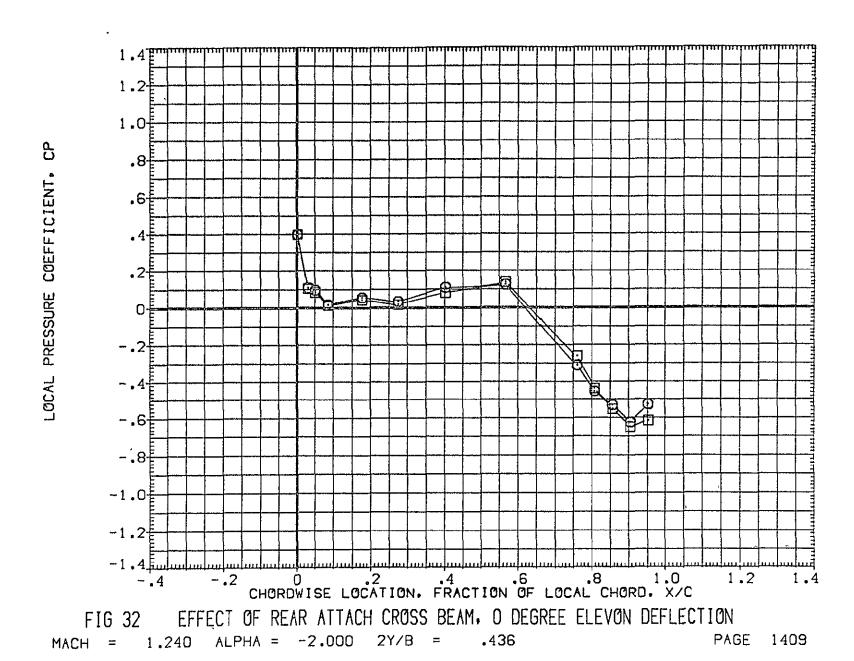






ELV-4

MACH = 1.240 ALPHA = -4.000 2Y/B = .771PAGE 1408



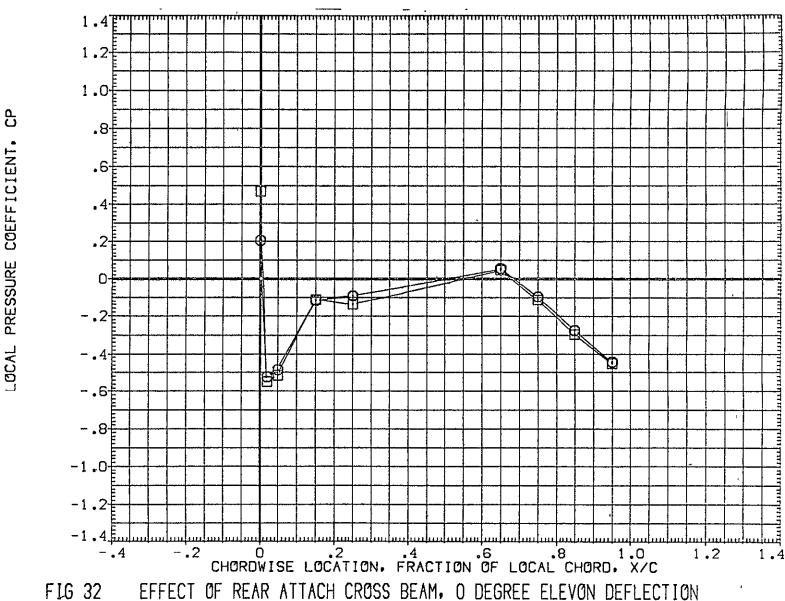
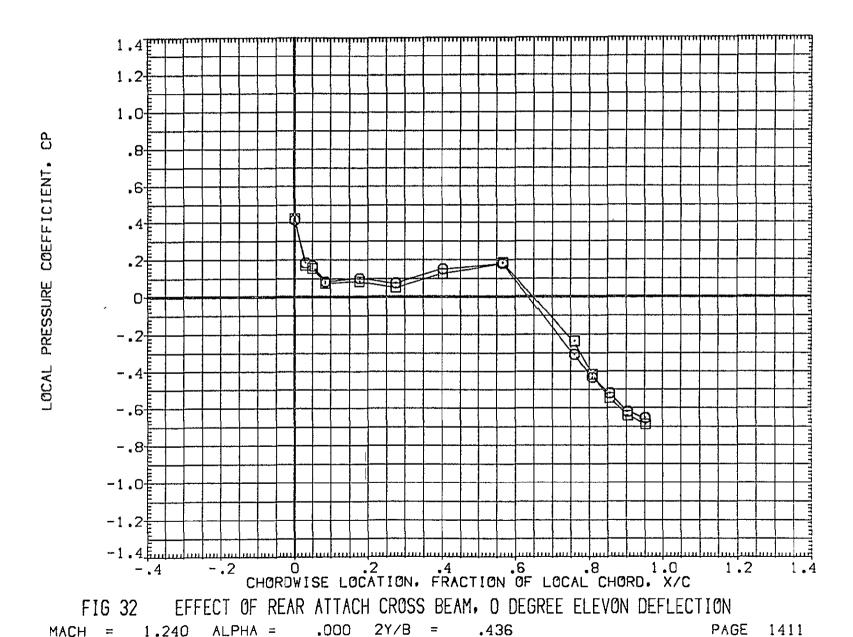
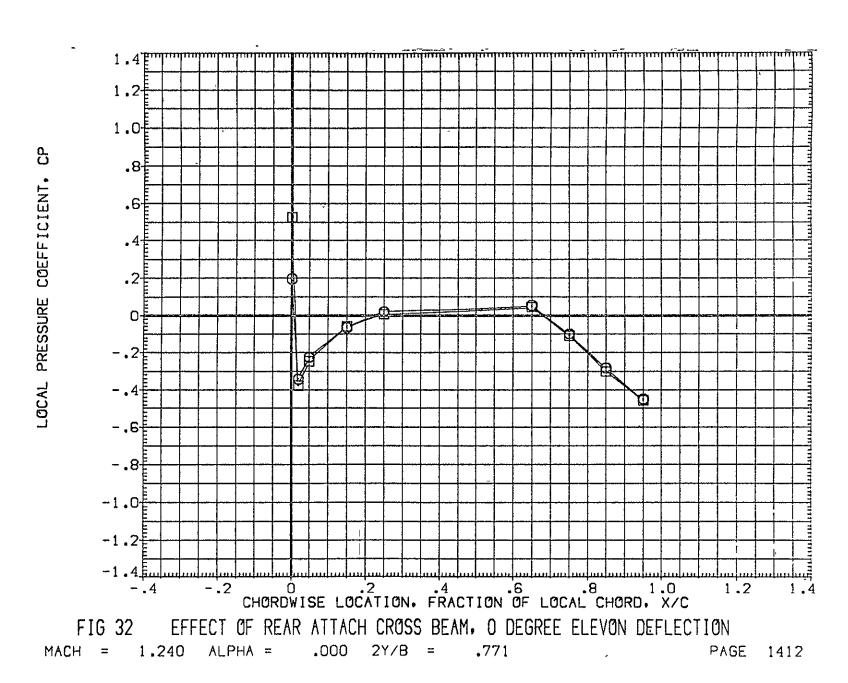
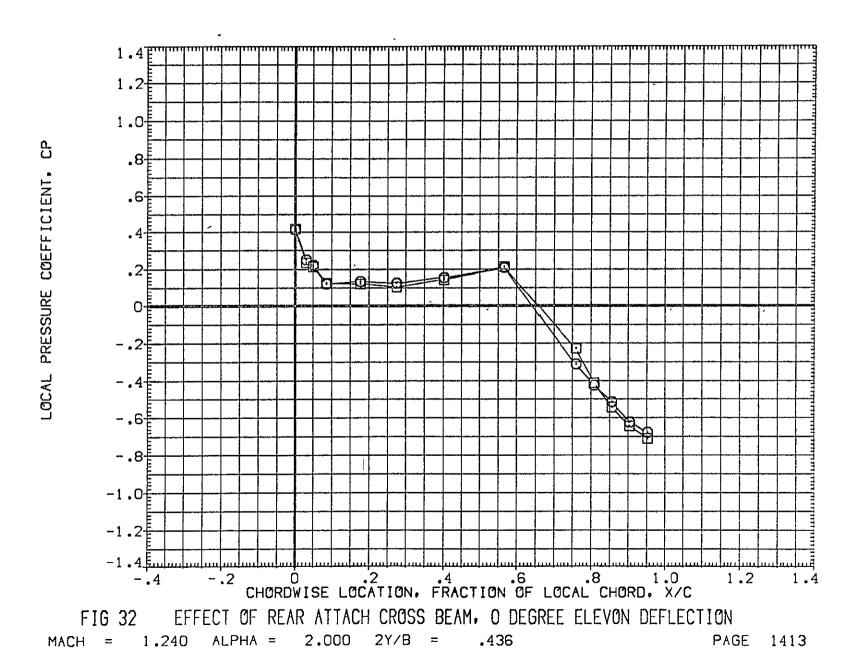


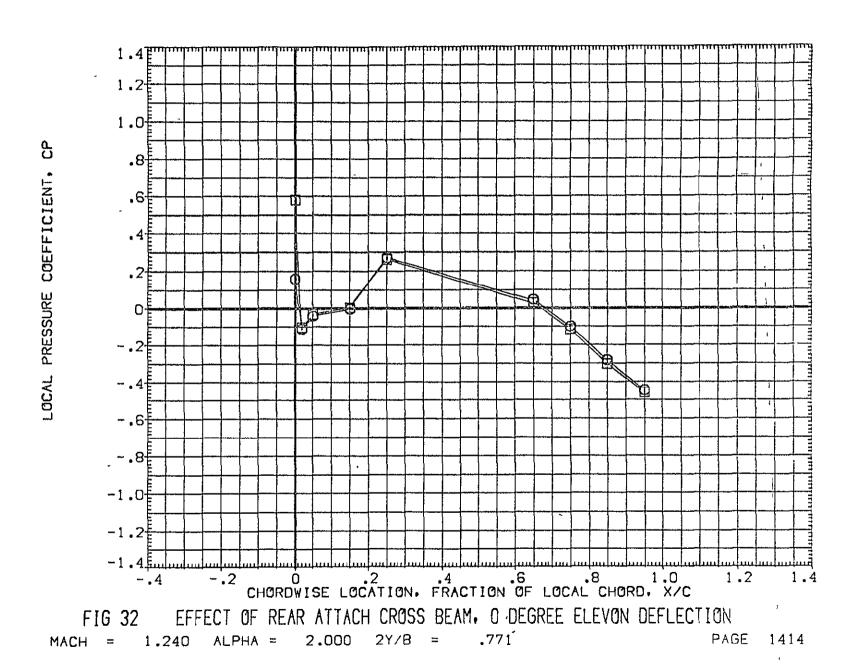
FIG 32 EFFECT OF REAR ATTACH CROSS BEAM, O DEGREE ELEVON DEFLECTION

MACH = 1.240 ALPHA = -2.000 2Y/B = .771 PAGE 1410









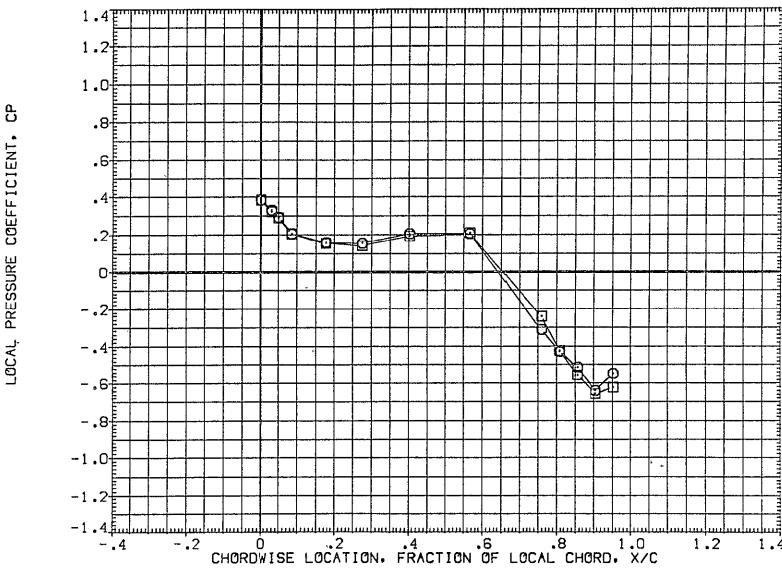


FIG 32 EFFECT OF REAR ATTACH CROSS BEAM, O DEGREE ELEVON DEFLECTION

